AN ASSESSMENT OF WATER QUALITY CONDITIONS AND REMEDIAL MEASURES IN WHEATLEY HARBOUR, LAKE ERIE

Ontario

Ministry of the Environment

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An Assessment of Water Quality Conditions and Remedial Measures in Wheatley Harbour, Lake Erie

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FOREWORD

This report serves as documentation of the Ministry's 1978-79 intensive survey in Wheatley Harbour, Lake Erie, and as an update on the status of water quality conditions, including an assessment of the effectiveness of remedial measures implemented from 1973 to 1982.

Since the 1980 release of the 1978-1979 harbour survey findings to the Ministry's Regional office and Omstead Foods Limited of Wheatley, Ontario, MOE regional industrial abatement staff have monitored the implementation of various remedial measures at Omstead Foods Limited. Following an in-depth review of the operation of the Omstead waste treatment facility during 1982, further required additions or modifications to the waste treatment facility are to be determined during early 1983. Effluent toxicity tests carried out in June 1982 revealed that the 96-hr LC50 for the effluent was not lethal. Similar results were obtained for the harbour waters at Stations 25 and 31.

Further toxicity tests are proposed during the peak canning season.

Presently, regional staff are conducting sediment studies in West Creek and Two Creeks drainage basins, investigating primarily the possible source(s) of PCB contamination identified in the 1978-1979 survey.

I SUMMARY OF FINDINGS

Substantial improvements in the water quality of Wheatley Harbour were observed in the 1978-1979 study when compared to conditions existing during earlier surveys over the period 1966 to 1973. These improvements are mainly due to remedial measures by Omstead Foods Limited which included the installation of another clarifier to increase the treatment facility's capacity and the addition of aerators in the lagoons. These measures have minimized the problem of sludge bulking which had frequently caused discharges of inadequately treated wastes particularly during the peak canning season.

During the spring 1978-79 investigations, high flows in Muddy Creek (38 x $10^3 m^3$/d, about tenfold the Omstead effluent flow), contributed to elevated levels of nitrate, suspended solids and bacterial counts in the harbour. However, spring dissolved oxygen levels, were well within the Provincial Objective of 6 mg/L at 5^oC (or 4 mg/L at 20^oC) for warm water biota. Because of the high exchange rate at the harbour outlet during this season, the adjacent Lake Erie area was affected by high bacterial counts, mainly fecal streptococci, which was most likely of animal origin.

During the peak canning season in September, the Omstead treated effluent (at a flow rate of 7.0 x $10^3 m^3$/d compared to the creek's flow of 1.5 x $10^3 m^3$/d), contributed to an impairment of the harbour quality similar to that observed in the spring. In addition, dissolved oxygen levels were below the Provincial Objectives (4 mg/L at 20^oC for warm water biota). Occasionally, low oxygen levels persisted as far as the harbour outlet.

The extent of impairment of the adjacent Lake Erie area during the fall was restricted to 200 m from the harbour outlet (Station 31) in a southwesterly direction and thus did not impinge on the Wheatley water supply.

During spring, the area in the vicinity of the intake exhibited bacterial levels well below the Provincial Objectives.

Sediment analyses revealed that chlorinated pesticides such as DDT and metabolities and alpha and beta chlordane were high in the inner harbour. PCB levels in the harbour sediments were within the MOE guideline for open water disposal with the exception of a station located upstream from Omstead discharges.

Outside the harbour, PCB levels were highest at two stations nearby the outlets of West and Two Creeks.

II RECOMMENDATIONS

Following an in-depth review of the operation of the waste treatment facility during 1982, upgrading of the existing effluent quality and any further required additions or modifications to the waste treatment facility are currently being investigated and will be guided by the following recommendations:

1. Effluent levels of BOD and total phosphorus should not exceed 15 and 1 mg/L, respectively.

2. The sanitary wastes of Omstead Foods Limited should be diverted to the proposed new Wheatley sewage treatment facility.

3. Omstead Foods Limited should initiate a monitoring program for the waste treatment plant's effluent for parameters such as BOD_5, suspended solids, total phosphorus, total filtered ammonia and fecal coliforms on a weekly basis. During the peak canning season, the frequency of effluent monitoring should be increased to at least 3 times per week. Results of the effluent monitoring should be reported to the Ministry on a monthly basis.

III INTRODUCTION

3.1 Background

Wheatley Harbour has long been a recognized water quality problem area and has been cited by the International Joint Commission since 1972 (2). Water quality degradation in the harbour has consisted of severe oxygen depletion and bacterial contamination primarily resulting from upstream discharges of treated organic wastes and nutrients from Omstead Foods Limited. Agricultural drainage to Muddy Creek and to some extent "housekeeping" activities of the commercial fishing fleet in the harbour have also contributed to this impairment.

A 1975 report by Kinkead and Hamdy (1) summarized water quality conditions for the period 1967 to 1973. That report indicated that wastewater discharges to the harbour resulted in objectionable sights and odours in Muddy Creek as well as contributing to nuisance algal and weed growth in the harbour.

The excessive algal growth and organic wastewater loadings had resulted in the depletion of dissolved oxygen below levels sufficient for the maintenance of fish habitat. Levels of public health indicator bacteria in the harbour also consistently exceeded Provincial Objectives for body contact recreation.

Water quality and sediment surveys of Wheatley Harbour and the adjacent Lake Erie area continue to be carried out in order to monitor the effectiveness of remedial measures begun in 1973. This report documents the 1978-79 status of water quality conditions in the harbour and assesses the impact of previous remedial measures.

3.2 Description of the Study Area

The Village of Wheatley is located on Highway #3 in the south-west corner of Kent County. The 1979 resident population of the Village

was 1,600, distributed among about 569 households (3). The harbour is located approximately 3.2 km south-west of the Village's political boundary. Industrial activity in the area is related to the processing of agricultural and fish products.

3.3 Wheatley Harbour

For the purposes of this report all of Wheatley Harbour, including the lower reach of Muddy Creek, will be considered, as well as the nearshore zone of adjacent Lake Erie extending about 1 km offshore and 2.5 km east (just beyond Two Creeks) and west (to Elmdale) from the outer harbour breakwalls (Figures 1 and 2). Since the previous study, improvements have been made to the harbour, including the dredging of 59 x 10^3 m^3 of sediment to provide additional dockage on the western side of the harbour. This project was completed in 1977 and land disposal methods were used. The surface area of the harbour was increased from 32 x 10^3 m^2 to 48 x 10^3 m^2. Additional improvements included the construction of an offshore breakwater for marine safety off the tip of the harbour's eastern pier.

3.4 Water Use

Wheatley Harbour serves as a major base for the Canadian commercial fishing fleet in the central basin of Lake Erie. Omstead Foods Limited has a large fish processing facility located along the eastern edge of the harbour. Along the western side of the harbour are dockage facilities for commercial fishing boats and limited wet slips for recreational craft. Also located on the western side of the harbour are the Omstead Foods Limited vegetable processing plant and a small commercial shipyard. The harbour receives treated industrial effluent from the Omstead Foods Limited treatment plant via Muddy Creek. Two shore based outlets of treated industrial waste water and cooling water are located in Muddy Creek at sampling stations 22 and 23, respectively (Figure 2). Omstead's sanitary waste is held in septic tanks. In adjacent Lake Erie, water uses

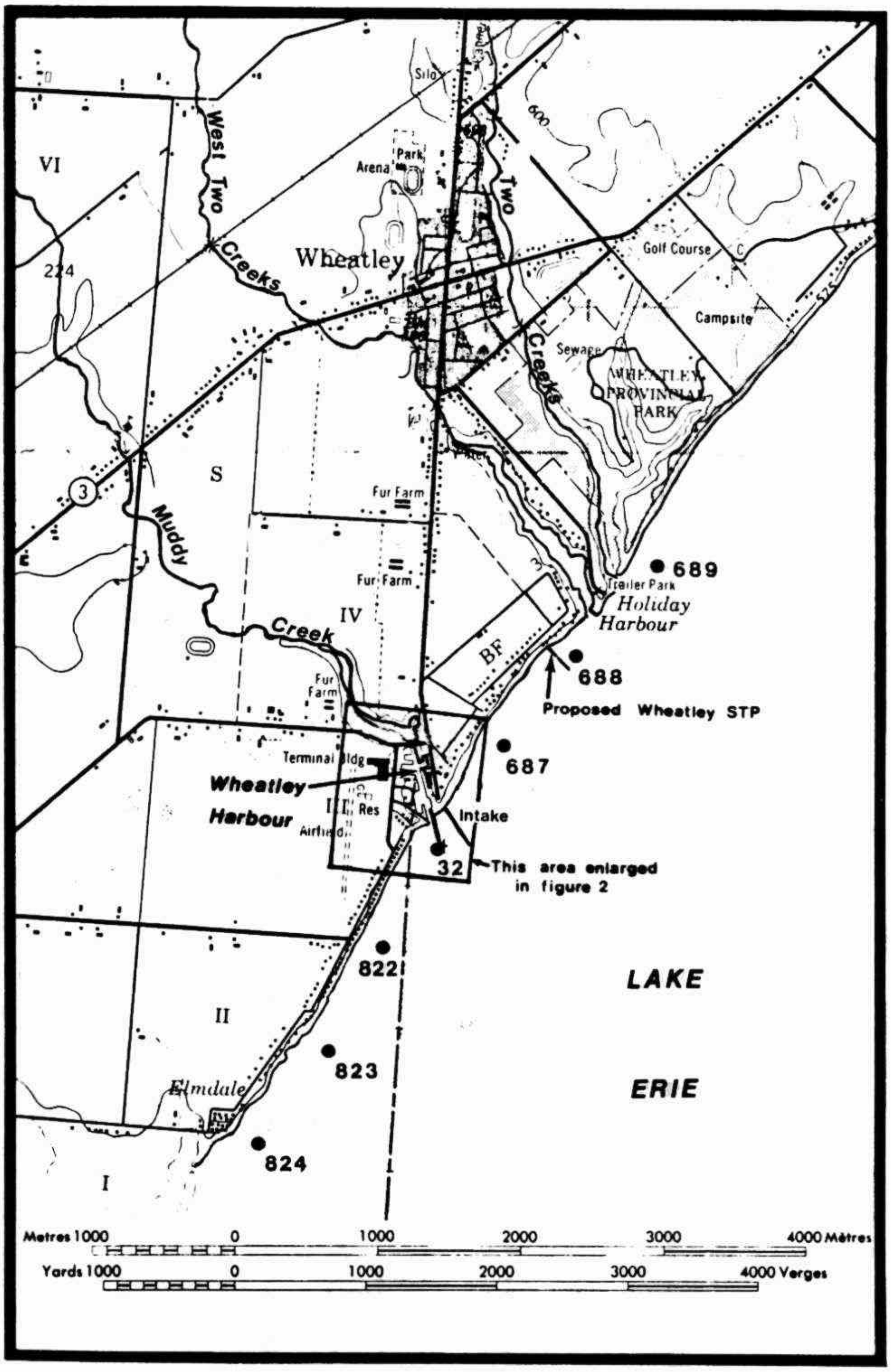


FIGURE 1. Wheatley Harbour Study Area and Station Locations Nearshore Lake Erie.

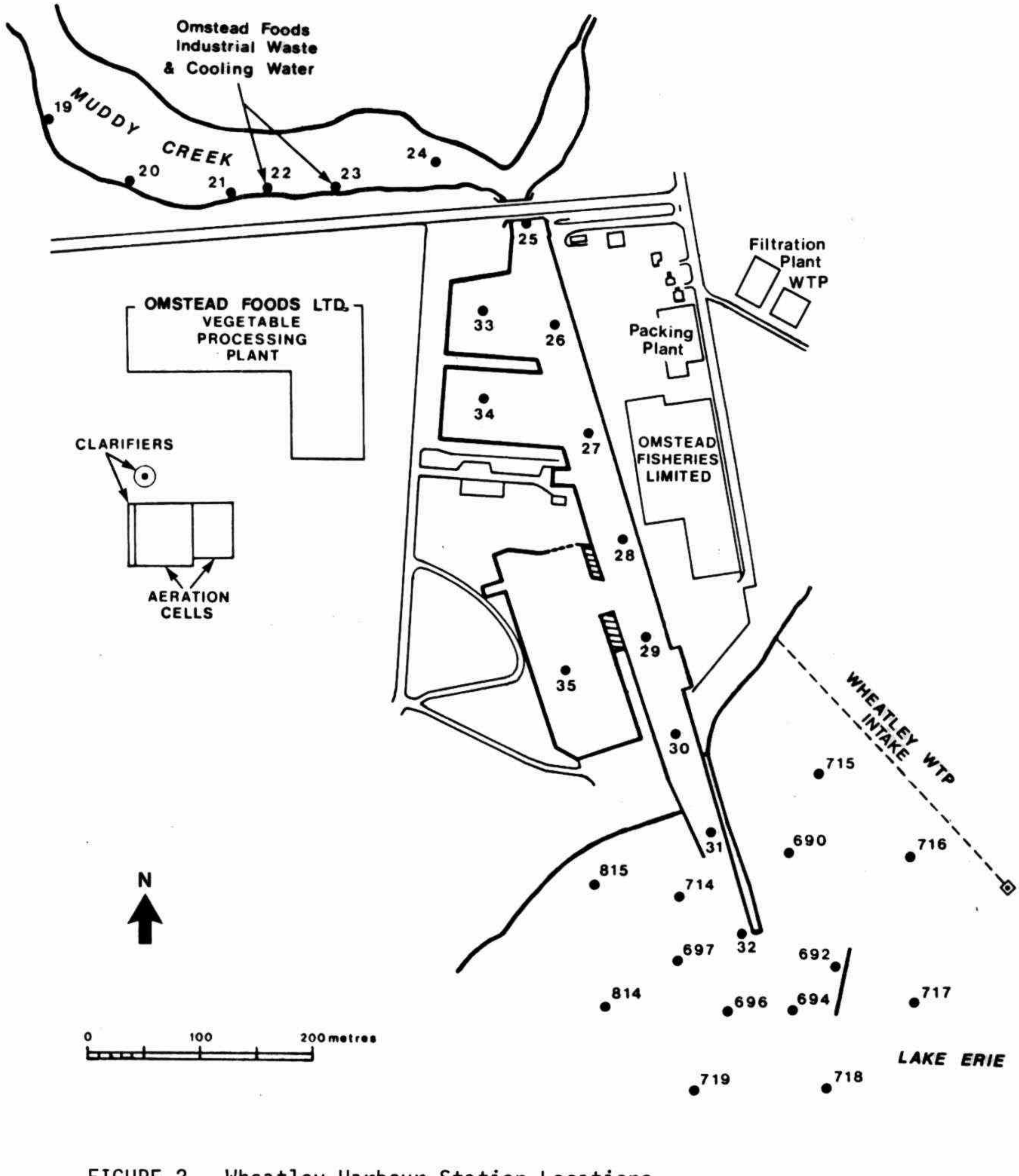


FIGURE 2. Wheatley Harbour Station Locations.

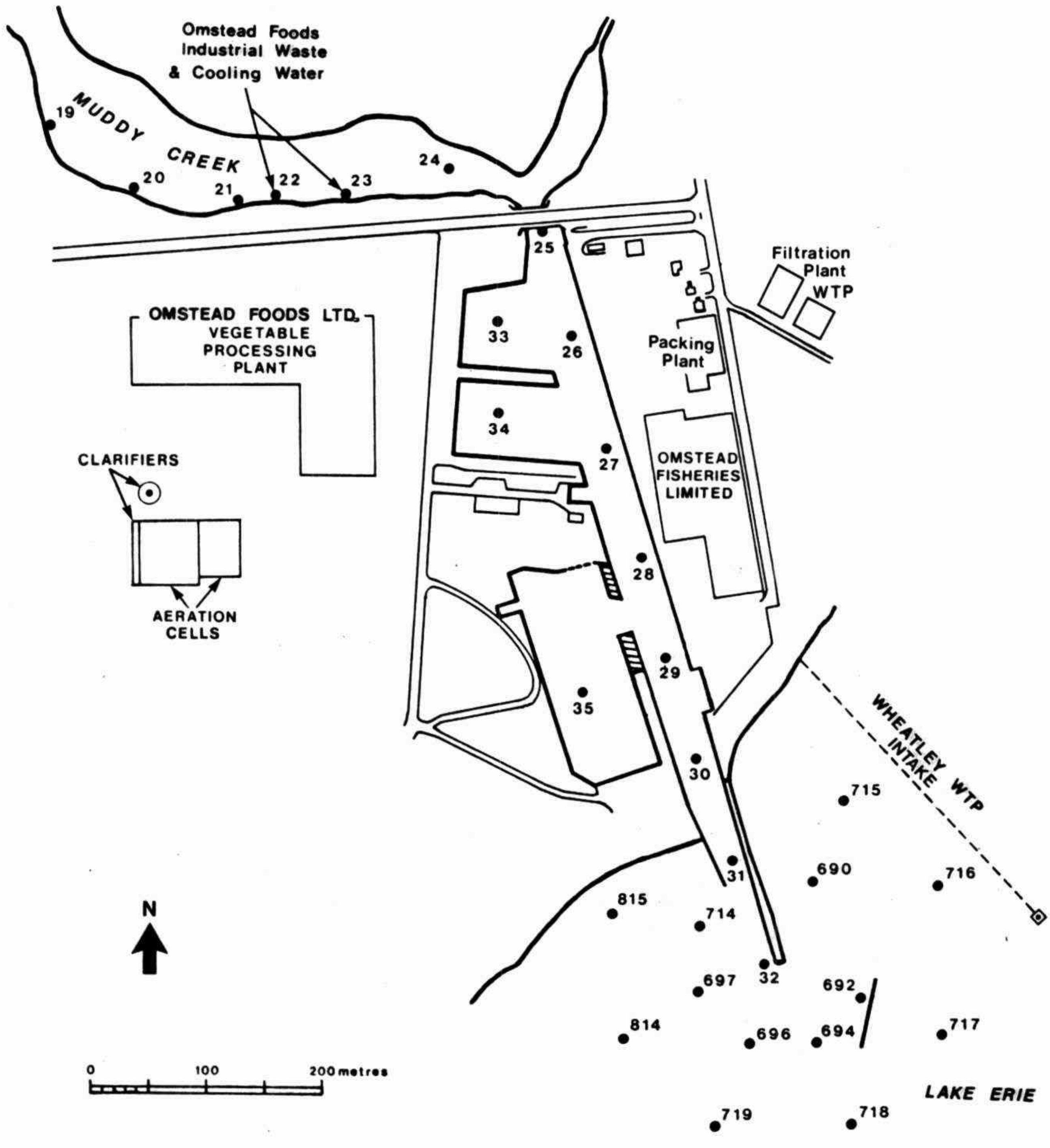
include the Village of Wheatley water supply intake located east of the harbour entrance about 366 m offshore. Treatment at the municipal water works (2.7×10^3 m^3/d) includes micro-straining, coagulation, sedimentation, pre-chlorination and filtration.

Natural sand beaches in the area provide an attraction for the recreational public with private camping and public park facilities located east of the harbour. A new proposed sewage scheme to replace septic tanks has been designed to service the Village of Wheatley and an adjoining portion of the Township of Romney is awaiting the resolution of financial arrangements. The system will consist of a 0.6 MIGD secondary treatment plant with a discharge through a diffuser outfall located 1.5 km east of the harbour, extending 460 m into the lake (Figure 1).

3.5 Survey Procedures

Field studies were conducted over three periods: September 21 - 24, 1978, April 3 - 11, 1979 and September 17 - 19, 1979. Fall surveys coincided with peak production runs at the vegetable processing plant. The sampling grid used was identical to that of previous studies (1967 to 1973) with the addition of three new stations (33, 34 and 35) in the recently enlarged portion of the harbour (Figure 2). A total of 17 water quality stations in the harbour and 18 stations in adjacent Lake Erie were sampled (Figure 2). Samples were collected at 1.5 m from surface except under conditions of thermal stratification where samples were taken at 1 m above the thermocline, midthermocline, 1 m below thermocline and 2 m off bottom.

Vertical profiling of dissolved oxygen and temperature using a YSI-54 ARC meter was conducted at all stations. The onboard water quality analyses included dissolved oxygen, pH, alkalinity, temperature, secchi disc depth and colour, and wind speed and direction were also taken. Field methods were followed in accordance with MOE Great Lakes sampling procedures (4).



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Shore based laboratory analyses included: nutrients, COD, BOD_5, conductivity, turbidity, chloride, total phenolics, chlorophyll a and public health indicator bacteria.

Sediments were sampled on all surveys and analyses performed for loss on ignition, total phosphorus, total Kjeldahl nitrogen, ether solubles, mercury, particle size, PCB's, and organochlorine pesticides (5,6).

IV STATUS OF REMEDIAL PROGRAMS

Since the previous Wheatley Harbour assessment in 1973 (1), several improvements and modifications have been made at the Omstead Foods Limited industrial waste treatment works. During the period of 1973 to 1978, a variety of housekeeping measures have been instituted in the fish and vegetable processing plants. Those improvements include screening and fish oil removal, pH regulation and the introduction of mechanical aerators in the lagoons. However, since the wastewaters pass through a small circular clarifier for settling prior to discharge to Muddy Creek, treatment capacity was found to be insufficient to handle peak wastewater inflows during the fall canning season. This resulted in problems of sludge bulking in the clarifier and inadequately treated wastes discharging to Muddy Creek.

By fall 1978, during the first survey year, an additional clarifier was installed to alleviate problems of sludge bulking and in turn insufficient treatment of discharged wastewater. In addition, two mechanical aerators were installed in the lagoons bringing the total to five.

In April 1979, two more aerators were added (seven in total), to increase aeration capacity in the lagoons. During September of the same year, an inspection by Regional staff indicated that although the problem of sludge bulking had been minimized, it had not been completely eliminated. A summary of discharge quality during the survey periods is shown in Table 1.

Currently, the Omstead Foods Limited plant does not have phosphorus removal or effluent disinfection, which may be considered for future improvements. Such additions or modifications to the waste treatment facility will be determined during 1983, subsequent to the waste treatment facility review completed by the Regional Industrial Abatement staff in 1982.

TABLE I
SUMMARY OF FINAL EFFLUENT
OMSTEAD FOODS LIMITED
WHEATLEY, ONTARIO

Sample Date	Flow ($x10^3$ m^3/d)	BOD_5 (mg/L)	Suspended Solids (mg/L)	Loading (kg/d) BOD	S.S
Sept. 1973[1)]	3.3	242	364	800	1200
Sept. 1978[1)]	4.0	100	475	400	1900
April 1979[2)]	3.6	53	54	200	190
Sept. 1979[2)]	7.2	65	12	470	86

Data Source

1. ONTARIO MINISTRY OF THE ENVIRONMENT

2. OMSTEAD FOODS LIMITED

V RESULTS AND DISCUSSION

5.1 Wheatley Harbour

Despite recent harbour improvements the mixing characteristics of the harbour appear to have remained similar to those described by Palmer (9); and Kinkead and Hamdy (1). There is no constant flushing action in the harbour due to its restricted outlet and low inflow from Muddy Creek relative to the harbour volume. Muddy Creek appears to be a factor in harbour flows only during spring runoff. Palmer indicated that water movements in the harbour are periodic and driven by wind seiche activity from adjacent Lake Erie. Periodic seiche activity has many effects, including upstream flow reversal in Muddy Creek. In such cases, the transport of Omstead effluents have been observed above the discharges to Muddy Creek (1).

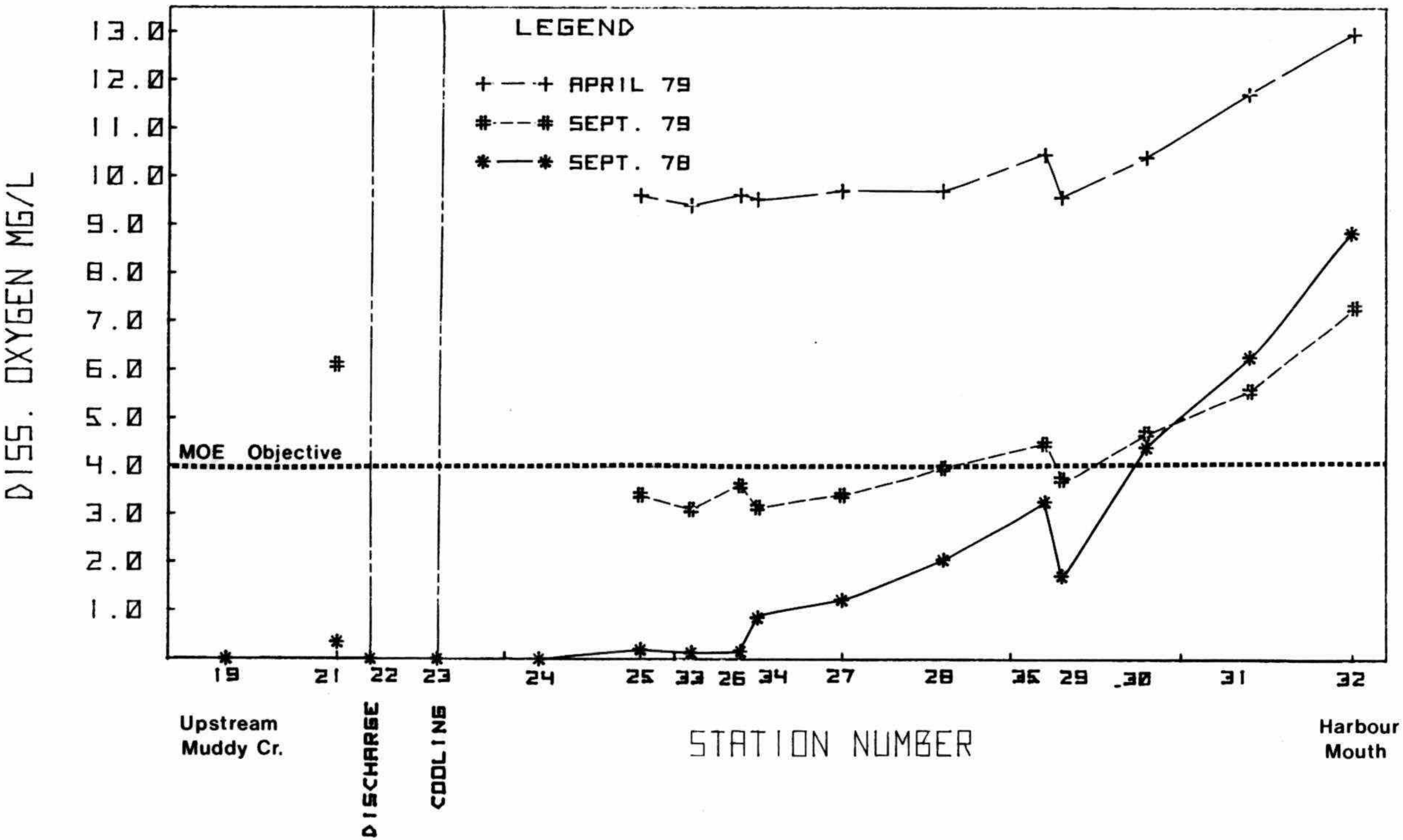
A summary of water quality measurements in the harbour is shown in Appendix I, page 31.

5.2 Dissolved Oxygen

As expected, dissolved oxygen levels (shown in figure 3, page 13) during April, 1979 were well above the Provincial Objective due to the high flows in Muddy Creek (38 x $10^3 m^3 d.$), (about tenfold the Omstead effluent flow) which resulted in efficient mixing of the effluent. Average levels of dissolved oxygen during September 1978 were below the Provincial Objectives (4 mg/L at 20^oC) to a distance of about 700 m (i.e. to the harbour outlet) from the Omstead outfalls. Anaerobic conditions during that year extended up to 500m from the source.

The September 1979 levels, however, showed significant improvement since average levels of about 3.0 mg/L were prevalent in the harbour. Dissolved oxygen profiles indicated levels did not go below 2.0 mg/L in 1979 (Figures 4 and 5). The improvement in dissolved oxygen levels in the harbour is attributed to the enhanced effluent treatment, and to the increase in the harbour surface area that would have provided greater wind-induced reaeration.

FIGURE 3. DISSOLVED OXYGEN LEVELS, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH



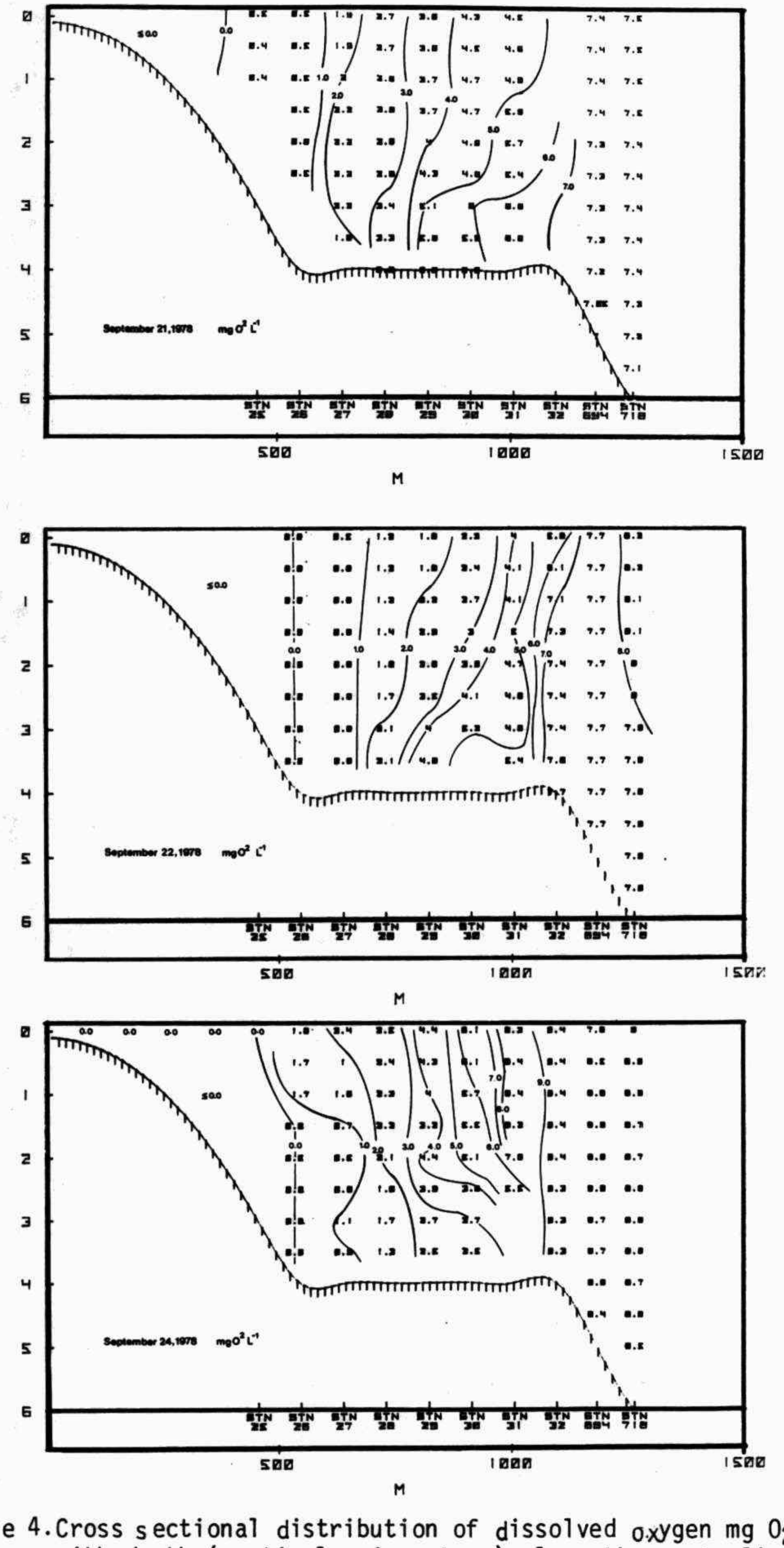


Figure 4. Cross sectional distribution of dissolved oxygen mg O_2 L^{-1} with depth (vertical axis meters) along the centreline of Wheatley Harbour (horizontal axis expressed in meters from station #19) during three cruise days of September 1978.

Contour interval 1 mg O_2 L^{-1}

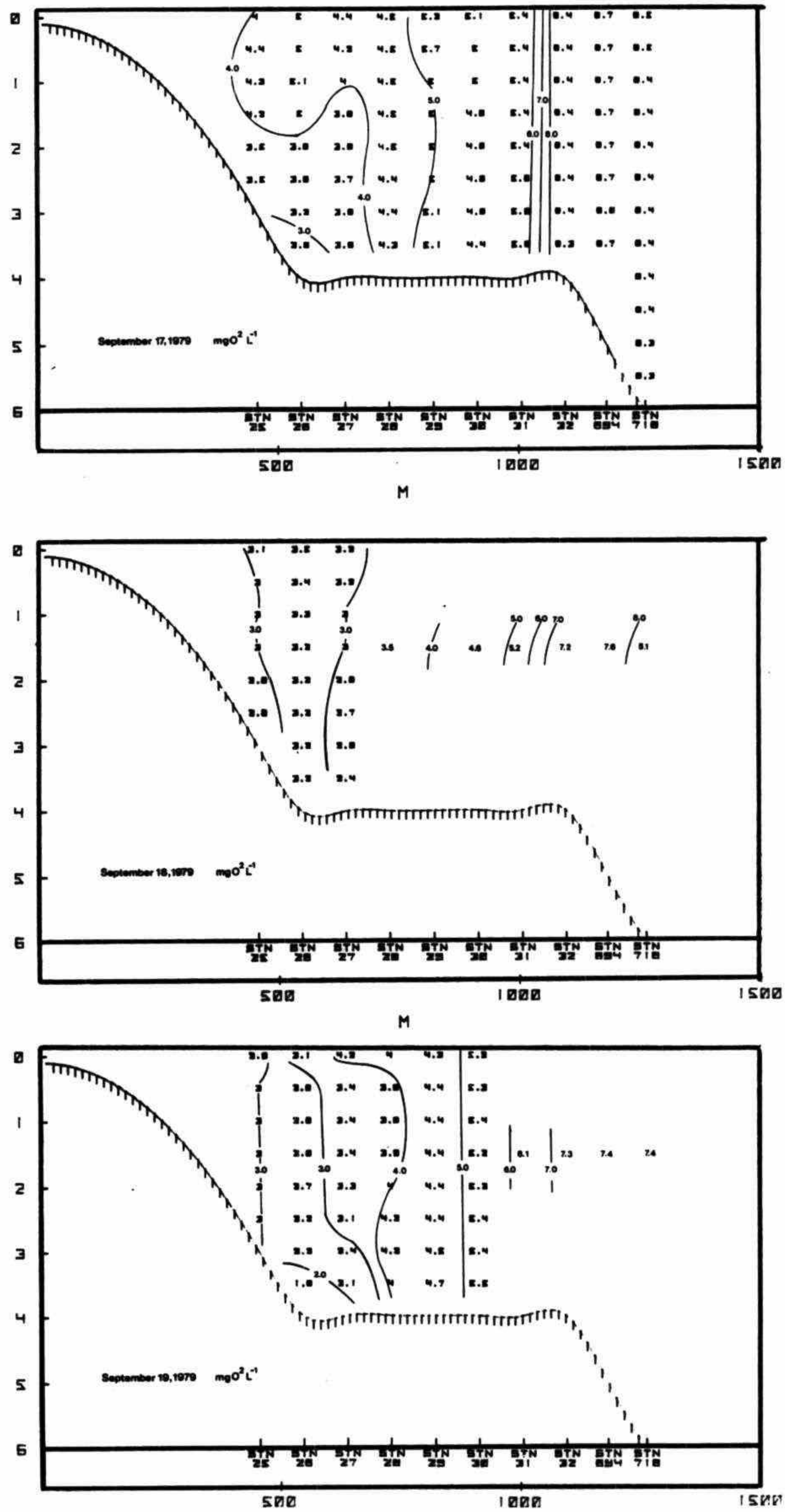


Figure 5. Cross sectional distribution of dissolved oxygen mg O_2 L^{-1} with depth (vertical axis meters) along the centreline of Wheatley Harbour (horizontal axis expressed in meters from station #19) during three cruise days of September 1979.

Contour interval 1 mg O_2 L^{-1}

5.3 Solids

The distribution of suspended solids in figure 6, page 17, demonstrates some apparent improvements in suspended solid levels over the three survey periods. During September 1978, high suspended solids of up to 543 mg/L at station 22, were indicated near the discharge due to a malfunction at the treatment plant. High suspended solids during the 1979 April survey were attributed to land runoff. September 1979 data indicate a significant reduction in suspended solids over the previous fall survey.

Omstead's treatment plant is not the sole source of suspended solids in the harbour. Other sources include washings from the cleaning of commercial fishing boats and the resuspension of harbour sediments by propeller wash, seiche and storm activity.

5.4 Nitrogen

During the two September cruises, total Kjeldahl nitrogen was the most dominant form of nitrogen in the harbour, followed (in order of concentration) by total filtered ammonia and nitrate plus nitrite (Figure 7). Filtered total ammonia exceeded nitrate plus nitrite concentrations in the main section of the harbour during the fall primarily due to the low oxygen levels which inhibited microbial oxidation of ammonia (Figures 8 and 9). Un-ionized ammonia levels based on pH level of 8 and average temperature of 22^{o}C during the fall surveys ranged from .057 mg/L near the outfall to .034 mg/L near the harbour outlet. These levels exceeded the Provincial Objective (0.020 mg/L) for the protection of aquatic life.

5.5 Public Health Indicator Bacteria

Geometric mean densities of fecal coliforms and fecal streptococci in the harbour exceeded the Provincial Objectives (100 and 20 counts/100 mL, respectively) during the 1978 and 1979 survey periods

FIGURE 6. SUSPENDED SOLIDS LEVELS, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH

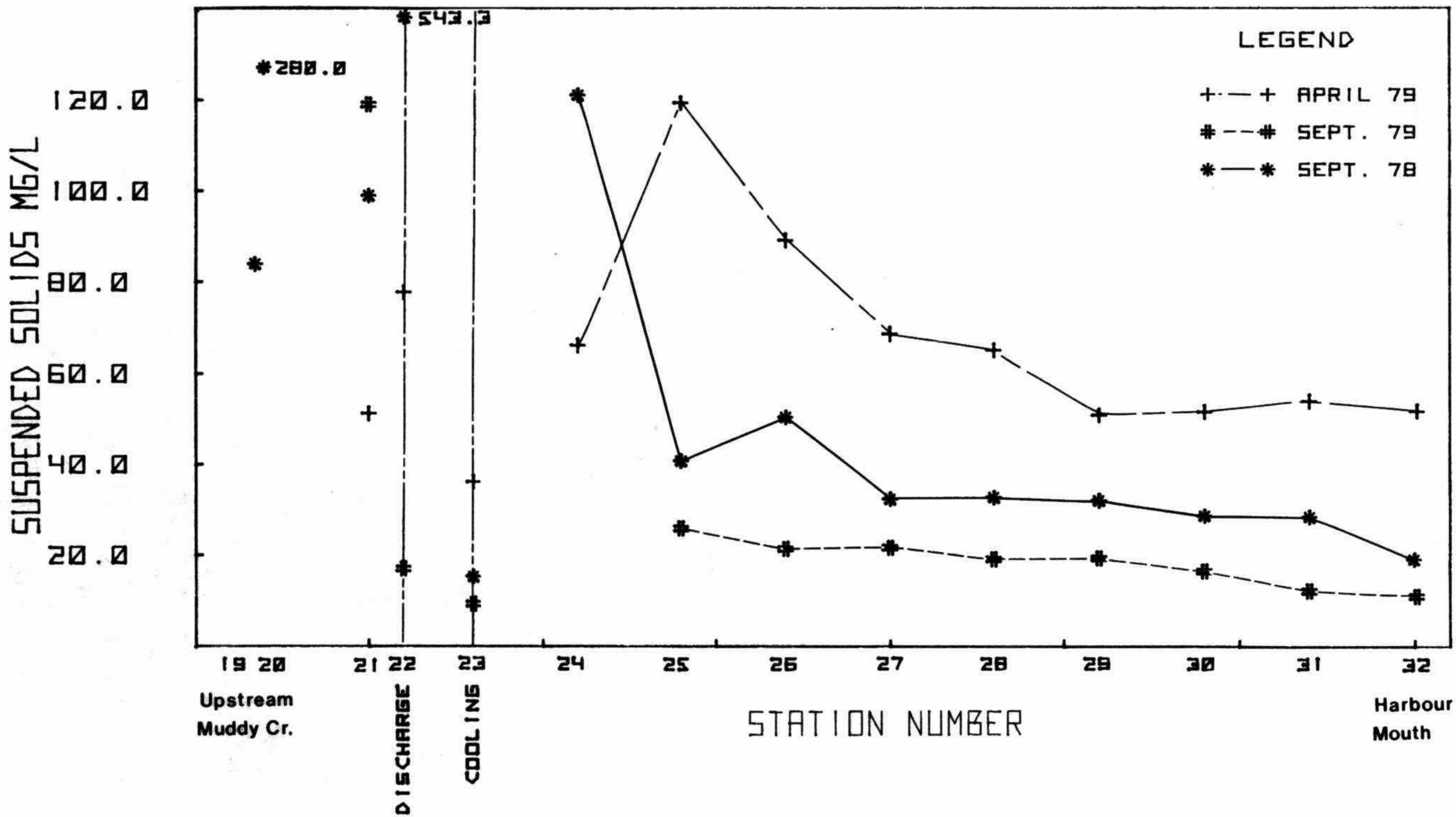


FIGURE 7. TOTAL KJELDAHL LEVELS, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH

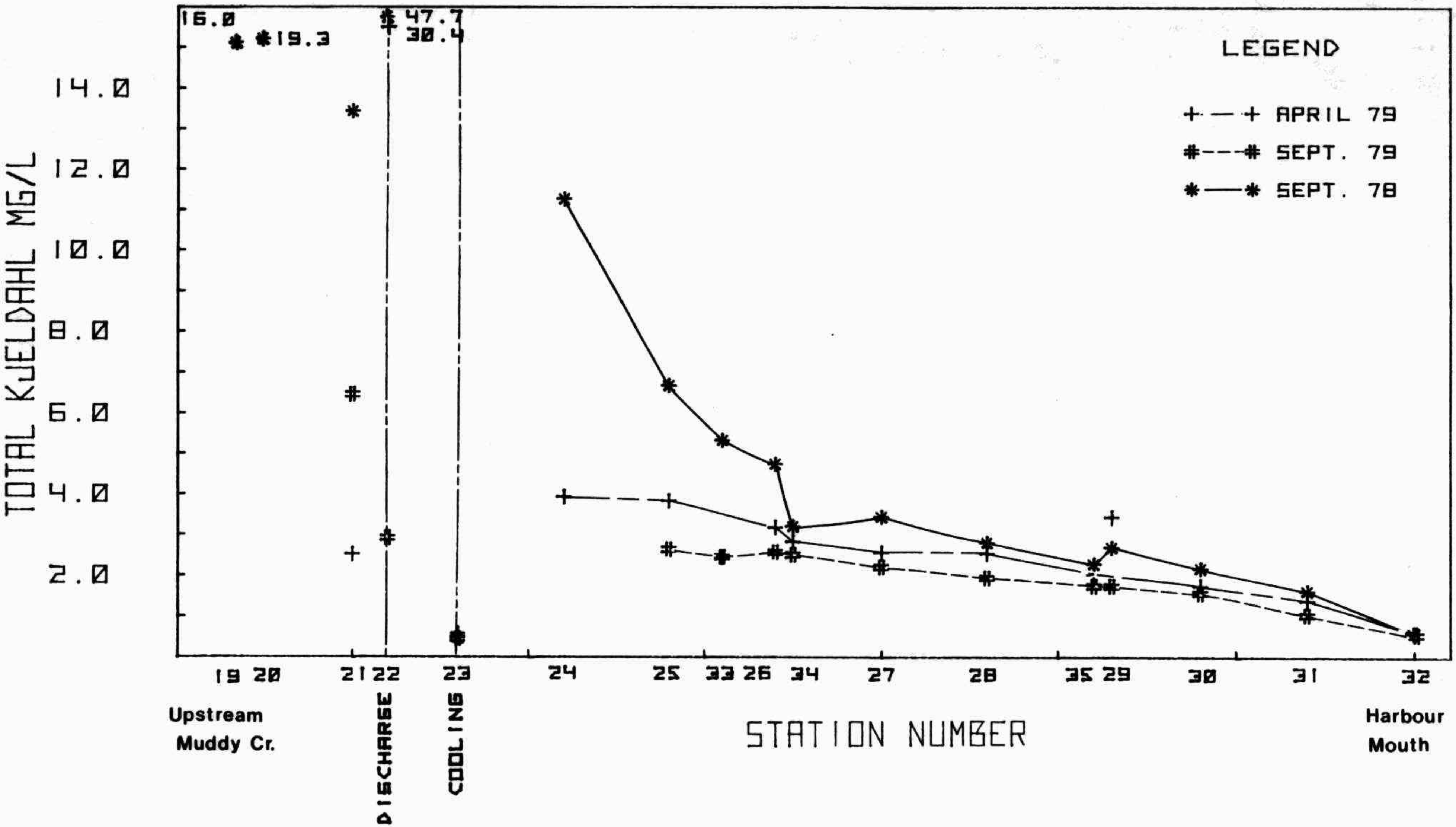


FIGURE 8. FILTERED AMMONIA LEVELS, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH

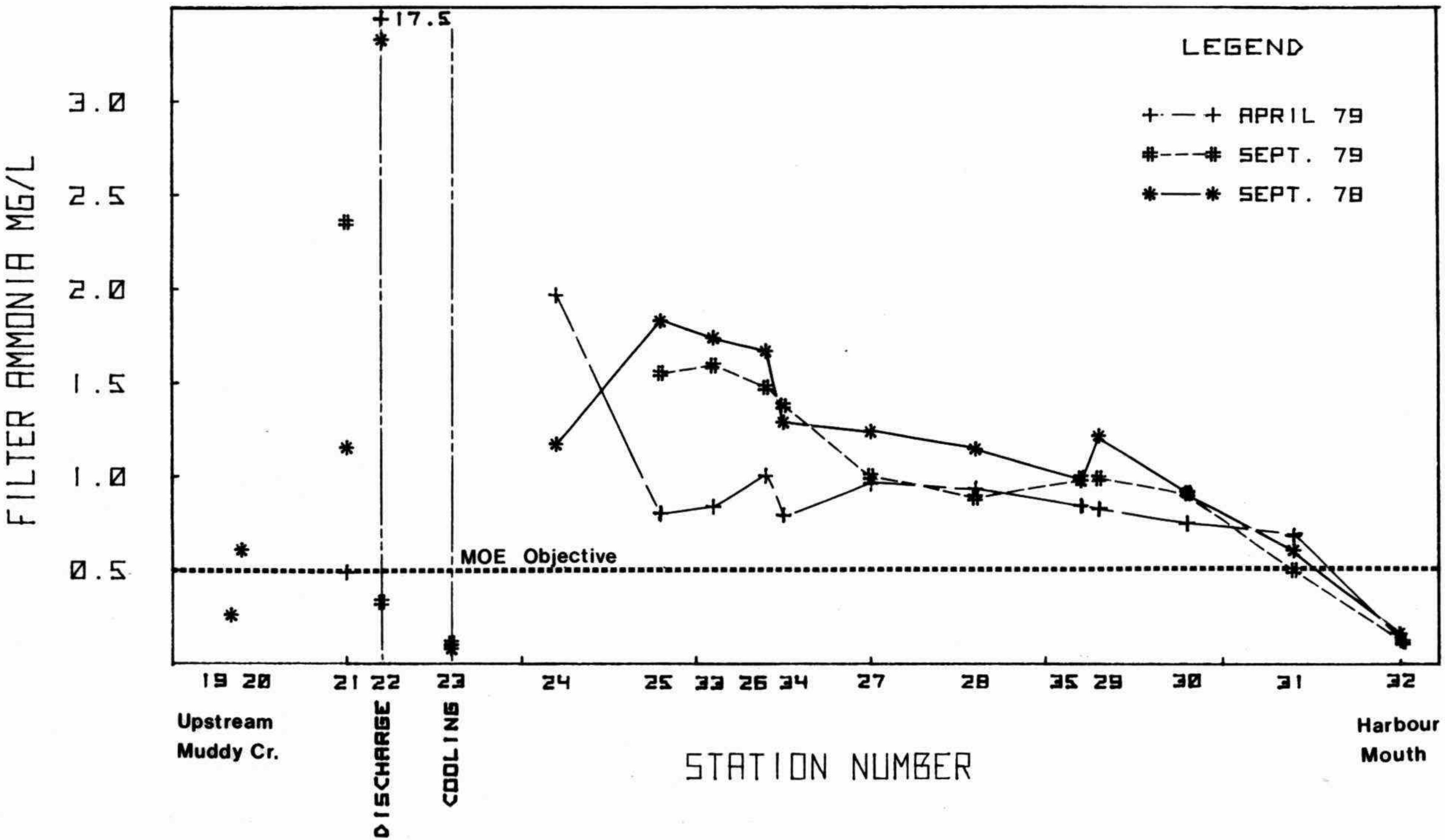
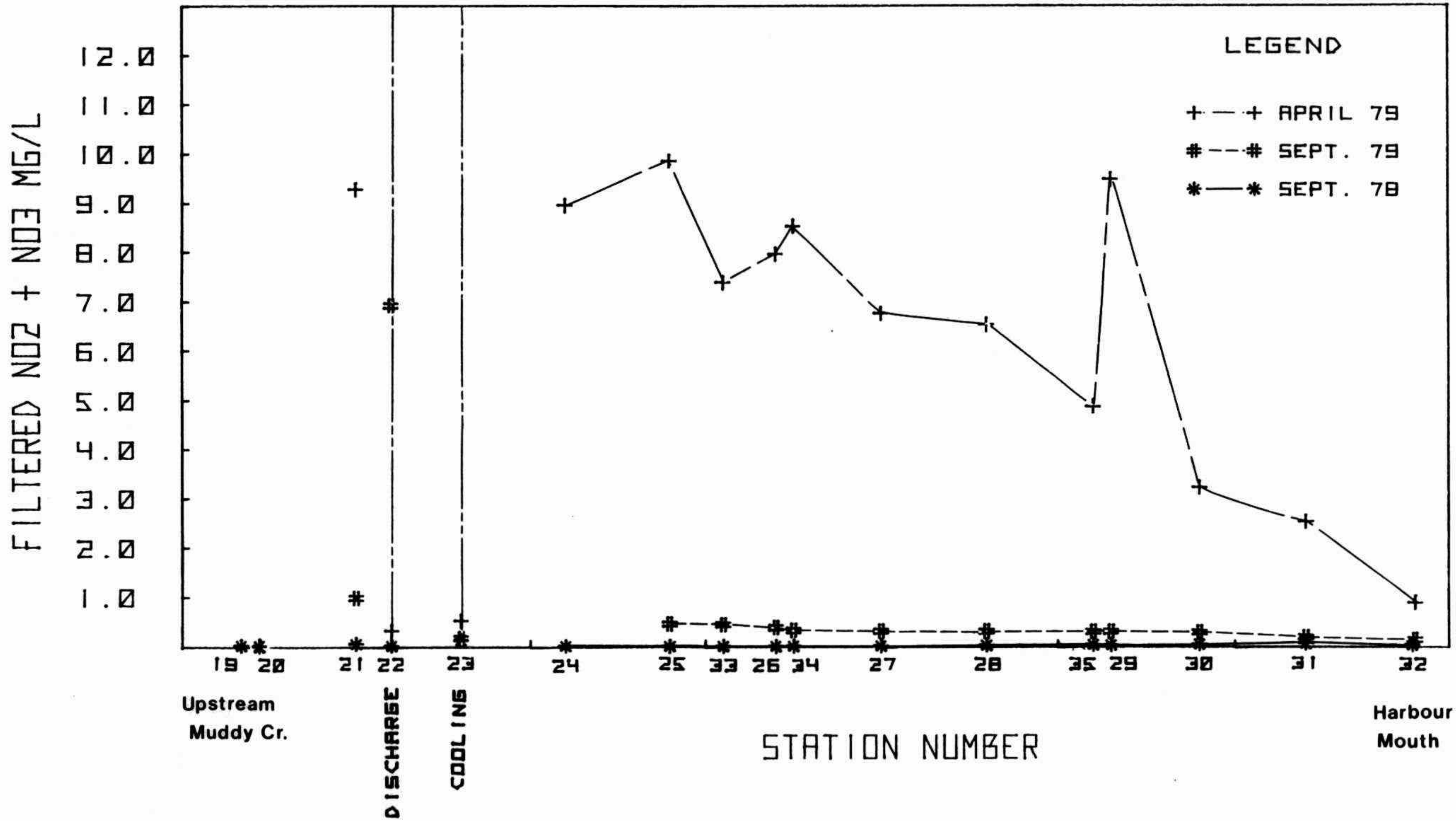


FIGURE 9. FILTERED NITRITE AND NITRATE LEVELS, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH



(Figures 10 and 11). Ratios of fecal coliforms to fecal streptococci (.01 - .05), near the discharge area were indicative of wastes of non-human origin especially during April, 1979 (11). During both September 1978 and 1979, contribution of domestic wastes was evident since the ratio was between 0.7 and 4.0. The domestic wastes of Omstead Foods Limited which are currently treated through septic tanks may have contributed to the bacterial contamination in the harbour. Pseudomonas aeroginosa (Figure 12), which is an indicator of a potential pathogen, was detected in the harbour; however, lower levels were found in September, 1979 (ranging up to 25 counts/100 mL), than those in 1978 (ranging up to 383 counts/100 mL).

5.6 Adjacent Lake Erie

A summary of water quality measurements in adjacent Lake Erie for the 1979 survey is shown in Appendix II, pages 36-41.

The zone of influence of the Wheatley Harbour discharge in Lake Erie extended to 200m from the harbour outlet in a southwesterly direction during the fall peak canning season. Fecal coliforms and fecal streptococci levels were significantly higher in this zone than at the remaining stations in the adjacent Lake Erie waters. Fecal coliform counts in the zone were, however, within the Provincial Water Quality Objective (100 counts/100 mL), whereas fecal streptococci levels exceeded the Objective for recreational use (20 counts/100 mL). The zone does not impinge on the municipal water intake nor on the recreational beaches adjacent to the harbour.

During the spring, all stations monitored in the adjacent lake waters exhibited levels similar to those at the harbour outlet. For example, high levels of nutrients (up to .862 mg/L for nitrite and nitrate at station 688), and bacterial counts, particularly fecal streptococci (up to 83 counts/100 mL, at station 689), were evident. Since fecal coliform levels were well within the Provincial Objective, the high occurrence of fecal streptococci counts is probably indicative of inputs of non-human origin and attributable to spring runoff in the Muddy Creek basin.

The area in the vicinity of the Wheatley water intake (stations 716, 717) exhibited bacterial levels well below the Provincial Objectives.

FIGURE 10. FECAL COLIFORM DENSITIES, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH

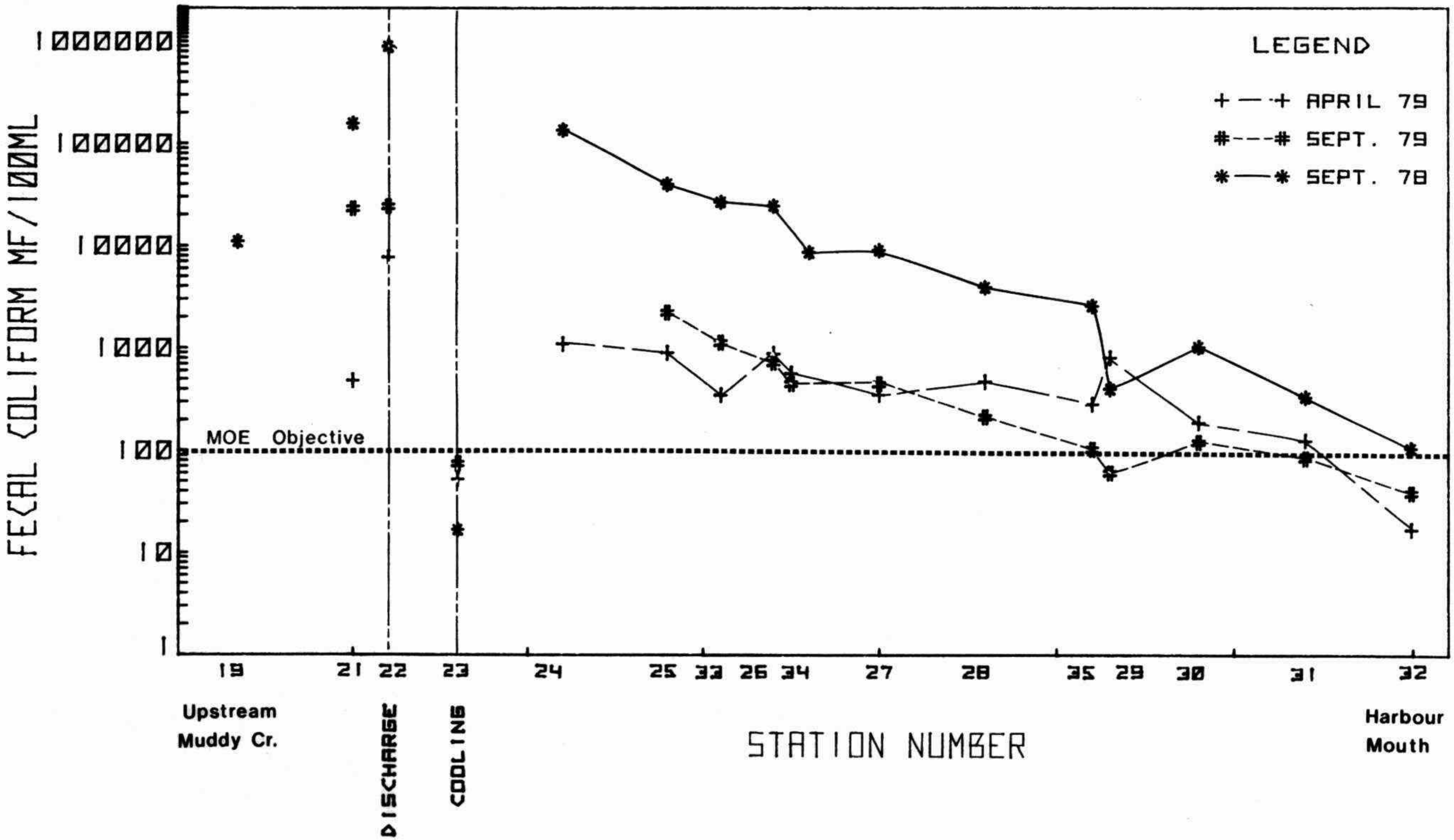


FIGURE 11. FECAL STREPTOCOCCI DENSITIES, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH

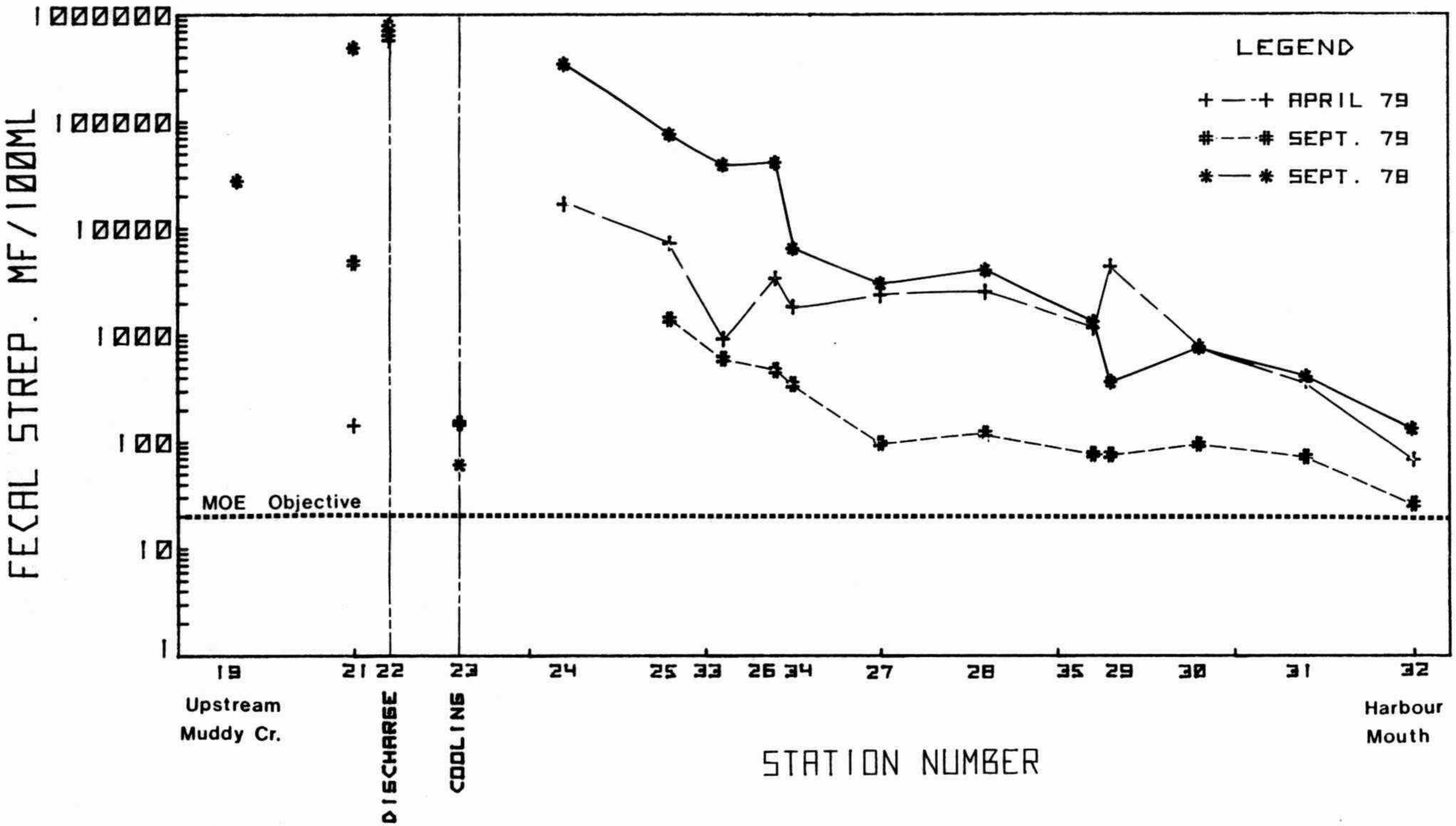
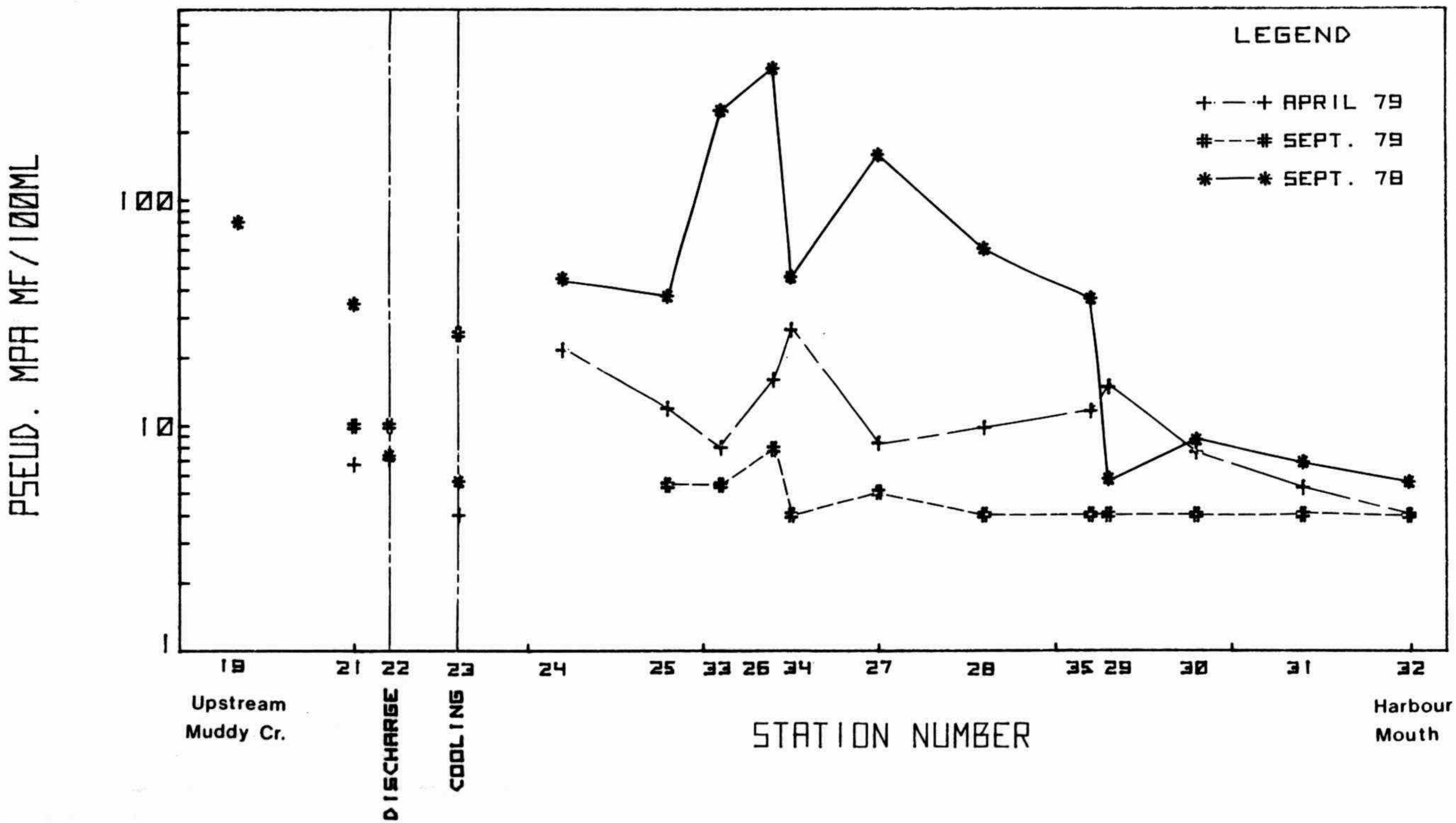


FIGURE 12. PSEUDOMONAS AEROGINOSA DENSITIES, OMSTEAD OUTFALLS TO WHEATLEY HARBOUR MOUTH



5.7 Other Characteristics

Total phosphorus levels exceeded the Provincial guideline (.020 mg P/L) for the prevention of nuisance growth throughout the harbour, and adjacent nearshore Lake Erie waters during all survey periods. There was a noticeable decline in total phosphorus levels in the Omstead treated effluent from 10 to 2 mg P/L from September 1978 to 1979.

Chlorophyll *a* levels were also extremely high especially during the peak canning season (September 1979), ranging from a mean of 98 ug/L near the Omstead process water outfall to an average of 9 ug/L at the harbour outlet. Dense rooted aquatic growth was observed near the Omstead outfall and floating algal mats were noted throughout the harbour.

5.8 Sediment Quality

Because of restricted exchange, extensive sedimentation occurs in the harbour; which results in the need for frequent maintenance dredging. Sediment contamination has necessitated the use of confined or land disposal techniques in recent years.

Tables 2 and 3 (pages 26 and 27) outline the characteristics of sediment samples taken during the 1978 and 1979 surveys. On September 23 and 24, 1978, seven harbour stations and four nearshore Lake Erie stations were sampled using core or grab sampling devices depending on the sediment type (Table 2). During the 1979 sediment surveys, April 10 and September 19, harbour stations 25 and 32 were sampled (Table 3).

Sediments in the harbour are characterized by a base of clay and silt with an overburden of dark organic matter. Sediment composition changes from this characteristic to a sand composition near the Harbour outlet at stations 31 and 32. Sediments at adjacent Lake Erie stations were sandy.

WHEATLEY HARBOUR
SEDIMENT CHEMISTRY
September 23 & 24, 1978

Table 2.

STATION NO.	21	24	25	27	27	27	29	29	29	31	31	32	688	689	814	824
DIST. FROM STN. #19 (m)	100	283	375	558	558	558	741	741	741	924	924	1015	LAKE ERIE	LAKE ERIE	LAKE ERIE	LAKE ERIE
SAMPLE DEPTH INTERVAL (cm)	0-5	0-5	0-5	0-5	5-10	10-15	0-5	5-10	10-13	0-5	5-10	0-5	0-5	0-5	0-5	0-5
STATION DEPTH (m)	0.5	0.5	1.0	3.5	3.5	3.5	4.0	4.0	4.0	3.5	3.5	4.0	4.0	2.0		4.0
SAMPLE DEVICE	PONAR	PONAR	PONAR	PHLEGAR CORE	PHLEGAR CORE	PHLEGAR CORE	PHLEGAR CORE	PHLEGAR CORE	PHLEGAR CORE	SHIPEK	SHIPEK	SHIPEK	SHIPEK	SHIPEK	SHIPEK	SHIPEK
FIELD DESCRIPTION	SILT	SILT	GRAVEL + ORGANIC	SILT + ORGANIC	SILT + CLAY	CLAY	CLAY + ORGANIC	CLAY	CLAY	COARSE SAND	COARSE SAND	SAND	COARSE SAND	COARSE SAND	FINE SAND	CLAY + GRAVEL
LOSS ON IGNITION (%)	16	28	2	13	17	18	9	3	5	3	3	2	2	3	3	4
TOTAL PHOSPHORUS (mg P g^{-1})	3.7	2.7	0.64	5.5	7.3	2.8	2.6	1.2	1.2	0.39	0.35	0.40	0.74	0.31	0.40	0.61
TOTAL KJELDAHL NITROGEN (mg N g^{-1})	8.6	9.0	0.91	7.0	8.8	6.2	3.8	1.2	1.7	0.43	0.27	0.48	0.23	0.42	0.24	0.65
PCB (ug Kg^{-1})	60	ND	36	20	NA	NA	ND	NA	NA	ND	NA	ND	950	710	55	70

Note: ND - Not detected
NA - Not analyzed

WHEATLEY HARBOUR
SEDIMENT CHEMISTRY 1979

Table 3.

Station Number		25	25	32	32
Sample Date		10-04-79	19-09-79	10-04-79	19-09-79
Dist. from Stn. 19 (m)		375	375	1015	1015
Sample depth interval (cm)		0-5	0-3	0-5	0-4.5
Sample device		Shipek	Shipek	Shipek	Shipek
Field description		Organic	Organic	Sand	Sand
Loss on ignition (%) (6% guideline)		27.8	20.0	1.1	1.4
Chemical Oxygen Demand (%) (5% guideline)			27		1.60
Total phosphorus (%) (0.1% guideline)		0.30	0.36	0.04	0.05
Total Kjeldahl Nitrogen (%) (0.2% guideline)		1.00	0.93	0.04	0.05
Ether Solubles mg/Kg (dry)		576	11300	317	586
PCBs (ug/Kg) (50 ug/Kg guideline)			180		36
BHC (ug/Kg)			ND		20
Lindane (ug/Kg)			ND		3
op DDT (ug/Kg)			7		ND
pp DDD (ug/Kg)			38		9
pp DDT (ug/Kg)			14		ND
Chlordane (ug/Kg)			15		3
Chlordane (ug/Kg)			13		3
Mercury (ug Hg/g) (0.3 ug/g guideline)		0.16	0.12		0.02
Gravel	2-4.75 mm (%)	3.2	0.6	---	---
Very Coarse Sand	1-2 mm (%)	2.2	0.9	0.1	0.4
Coarse Sand	0.5-1.0 mm (%)	3.9	2.2	0.5	1.0
Medium Sand	0.25-0.5 mm (%)	6.5	9.4	9.5	11.7
Fine Sand	0.125-0.25 mm (%)	10.6	11.7	76.0	64.3
Very Fine Sand	0.0625-0.125 mm (%)	4.1	10.0	8.3	12.9
Silt	0.005-0.0625 mm (%)	32.8	46.1	0	9.3
Clay	0.005 mm (%)	36.7	19.0	5.6	---

Note:- ND - Not Detected
- Blanks indicate no analysis performed;
- HCB: BHC; Heptachlor; Aldrin; Heptachlor epoxide; Thiodan I and II; pp DDE; Dieldrin; Endrin and Mirex were not detected during September 1979 sampling at stations 25 and 32.
- MOE guideline level below which sediment is suitable for open water disposal.

During 1979, surface sediments in the inner harbour (Station 25) were characterized by high organic content (20.0 to 27.8% loss on ignition), and high chemical oxygen demand (270 mg/g; Table 3). Organic sludge deposits in the inner harbour are related to the deposition of settleable solids from the upstream discharge. The organic content of the sediment is believed to exert a large oxygen demand on the bottom waters of the harbour. Levels of total phosphorus (0.30 to 0.36%) and total Kjeldahl nitrogen (1.00 to 0.93 %) were several orders of magnitude higher than corresponding levels near the harbour mouth and outside the harbour (0.04 to 0.05 % for both parameters).

Detected levels of chlorinated pesticides such as DDT and metabolites, and alpha and beta chlordane were highest in the inner harbour, with ranges from 7 to 38 ug/kg. Chlorinated hydrocarbons (footnote, Table 3) were not detected in harbour sediments. Sources of chlorinated pesticides were not confirmed, however, their presence may possibly be the result of upstream agricultural land drainage to Muddy Creek.

As shown in Table 3, 1979 levels of PCBs exceeded the MOE dredging guideline at station 25 in the harbour, but were within the guideline at the harbour outlet at station 32. These results generally agree with those documented by Thomas and Mudroch (12) in their studies of Wheatley Harbour as part of the small craft harbours investigations.

It is worth noting that samples collected in 1978 (Table 2), using a Ponar dredge (rather than the Shipek sampler used in 1979), exhibited low PCB levels in the harbour sediments, suggesting that the Ponar dredge may not be as suitable a sampling device.

Outside the harbour, the 1978 sampling using a Shipek sampler, revealed high PCB levels of 950 and 710 ug/kg at lake stations 688 and 689, respectively. These levels suggest a potential source of contamination from the adjacent West Creek and Two Creeks drainage basins, since the recommended guideline for PCBs for open water dredged spoils disposal is 50 ug/kg.

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APPENDIX I Water Quality Data for Wheatley Harbour Stations

Parameter	Units
B.O.D.	mg/L
Dissolved Oxygen	mg/L
Chlorophyll A	ug/L
Secchi Disc	m
Conductivity	us/cm
Turbidity	FTU
Suspended Solids	mg/L
Filtered Ammonia	mg/L
Phenols	ug/L
Alkalinity	mg/L
Chloride	mg/L
Total Phosphorus	mg/L
Reactive Phosphorus	mg/L
Nitrate + Nitrite	mg/L
Kjeldahl Nitrogen	mg/L
Fecal Coliforms	counts/100 mL
Fecal Streptococci	counts/100 mL
Pseudomonas	counts/100 mL
pH in field	

APPENDIX I Water Quality Data for Wheatley Harbour Stations

mean ± SD
(minimum–maximum)
N

ST.	B.O.D. mg/l			DISSOLVED OXYGEN mg/l			CHLOROPHYLL A ug/l			SECCHI DISC m		
	1978	1979		1978	1979		1978	1979		1978	1979	
	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER
32	2,400±0,693 (2,000-3,200) 3	2,100±1,352 (0,600-3,600) 4	0,833±0,321 (0,600-1,200) 3	8,900±3,253 (6,600-11,20) 2	12,900±0,239 (12,60-13,20) 8	7,250±0,071 (7,200-7,300) 2	14,333±8,712 (5,900-23,30) 3	8,250±2,051 (6,80-9,70) 2	8,767±0,945 (7,700-9,500) 3	0,500±0,000 (,5000-,5000) 4	0,180±0,042 (0,100-0,200) 10	0,700±0,224 (0,500-1,000) 7
31	3,733±1,222 (2,400-4,800) 3	2,050±0,597 (1,400-2,800) 4	1,933±0,987 (0,800-2,600) 3	6,267±1,701 (5,000-8,200) 3	11,700±0,668 (11,10-12,50) 4	5,567±0,473 (5,200-6,100) 3	33,400±15,850 (15,10-42,80) 3	7,400±0,141 (7,30-7,50) 2	15,950±0,636 (15,50-16,40) 2	0,400±0,089 (0,300-0,500) 6	0,133±0,052 (0,100-0,200) 6	0,833±0,258 (0,500-1,000) 6
30	5,467±1,405 (4,000-6,800) 3	2,400±1,166 (1,200-4,000) 4	2,967±0,473 (2,600-3,500) 3	4,400±1,277 (3,000-5,500) 3	10,400±2,106 (7,300-12,00) 4	4,700±0,141 (4,600-4,800) 2	48,500±1,452 (47,00-49,90) 3	8,650±4,738 (5,30-12,0) 2	25,050±5,303 (21,30-28,80) 2	0,367±0,103 (0,300-0,500) 6	0,133±0,052 (0,100-0,200) 6	0,400±0,115 (0,300-0,500) 4
29	6,133±1,222 (4,800-7,200) 3	2,850±0,839 (2,000-4,000) 4	2,767±0,751 (2,000-3,500) 3	3,267±0,404 (2,900-3,700) 3	10,450±2,217 (7,200-12,20) 4	4,467±0,503 (4,000-5,000) 3	54,867±3,209 (51,60-58,20) 3	6,150±1,909 (4,80-7,50) 2	25,100±5,515 (21,20-29,00) 2	0,333±0,052 (0,300-0,400) 6	0,133±0,052 (0,100-0,200) 6	0,400±0,089 (0,300-0,500) 6
28	7,733±2,203 (5,200-9,200) 3	3,200±0,864 (2,000-4,000) 4	3,267±1,206 (2,000-4,400) 3	2,067±0,611 (1,400-2,600) 3	9,700±2,017 (6,900-11,40) 4	3,967±0,503 (3,500-4,500) 3	60,400±33,874 (29,80-96,80) 3	5,200±3,253 (2,90-7,50) 2	25,050±7,566 (19,70-30,40) 2	0,300±0,000 (0,300-0,300) 6	0,133±0,052 (0,100-0,200) 6	0,367±0,103 (0,300-0,500) 6
27	9,467±3,402 (5,600-12,00) 3	3,200±1,131 (2,400-4,800) 4	3,133±0,416 (2,800-3,600) 3	1,233±0,839 (0,700-2,200) 3	9,700±2,003 (6,800-11,40) 4	3,400±0,566 (3,000-3,800) 2	72,800±15,320 (59,60-89,60) 3	6,550±3,182 (4,30-8,80) 2	31,250±2,758 (29,30-33,20) 2	0,267±0,052 (0,200-0,300) 6	0,133±0,052 (0,100-0,200) 6	0,500±0,231 (0,300-0,700) 4
26	14,733±2,003 (13,20-17,00) 3	4,500±1,612 (3,200-6,800) 4	4,133±0,924 (3,600-5,200) 3	0,500±0,000 (0,500-0,500) 1	9,600±1,506 (7,400-10,80) 4	3,600±1,249 (2,600-5,000) 3	83,200±14,516 (72,00-99,60) 3	7,200±1,414 (6,20-8,20) 2	35,867±4,277 (31,20-39,60) 3	0,267±0,052 (0,200-0,300) 3	0,133±0,052 (0,100-0,200) 6	0,367±0,103 (0,300-0,500) 6
25	26,067±11,240 (17,00-39,00) 3	7,000±4,543 (3,600-13,20) 4	5,800±0,600 (5,200-6,400) 3	0,400±0,000 (0,400-0,400) 1	9,600±1,506 (7,400-10,80) 4	3,400±0,693 (3,000-4,200) 3	137,100±0,000 (137,1-137,1) 1	9,000±0,849 (8,40-9,60) 2	42,433±6,591 (35,20-48,10) 3	0,200±0,000 (0,200-0,200) 2	0,100±0,000 (0,100-0,100) 6	0,400±0,115 (0,300-0,500) 4
24	83,000±92,666 (29,00-190,0) 3	6,400±2,939 (4,000-10,40) 4	*	*	*	*	199,400±0,000 (199,4-199,4) 1	3,700±2,404 (2,00-5,40) 2	*	0,100±0,000 (0,100-0,100) 2	*	*
23	2,600±1,311 (1,400-4,000) 3	3,250±1,893 (2,000-6,000) 4	1,400±0,529 (1,000-2,000) 3	*	*	*	10,200±0,000 (10,20-10,20) 1	10,40±0,000 (10,4-10,4) 1	11,767±5,558 (7,700-18,10) 3	0,100±0,000 (0,100-0,100) 2	*	*
22	300,0±261,534 (60,00-540,0) 3	50,050±53,504 (16,80-130,0) 4	8,600±0,529 (8,200-9,200) 3	*	*	*	3,000±0,000 (3,000-3,000) 1	4,150±3,748 (1,50-6,80) 2	5,400±1,706 (4,000-7,300) 3	0,100±0,000 (0,100-0,100) 2	*	*
21	62,000±26,458 (42,00-92,00) 3	5,500±5,670 (2,400-14,00) 4	14,000±4,613 (10,40-19,20) 3	0,700±0,000 (0,700-0,700) 1	*	6,100±0,000 (6,100-6,100) 1	222,800±0,000 (222,8-222,8) 1	2,100±0,283 (1,90-2,30) 2	96,300±39,262 (56,90-135,0) 3	0,100±0,000 (0,100-0,100) 2	*	*
20	96,500±61,518 (53,00-140,0) 2	*	*	*	*	*	650,300±0,000 (650,0-650,0) 1	*	*	0,100±0,000 (0,100-0,100) 2	*	*
19	71,000±0,000 (71,00-71,00) 1	*	*	*	*	*	*	*	*	*	*	*

ST. №	CONDUCTIVITY us/cm			TURBIDITY FTU			TOTAL SOLIDS mg/l			SUSPENDED SOLIDS mg/l		
	1978	1979		1978	1979		1978	1979		1978	1979	
	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER
32	294. ±11,016 (284,0-306,0) 3	296. ±12,148 (284,0-313,0) 4	284. ±5,292 (278,0-288,0) 3	11,100±1,652 (9,300-13,00) 3	57,750±39,059 (22,00-94,00) 4	6,300±2,352 (4,000-8,700) 3	184,67±17,244 (166,0-200,0) 3	264,50±65,917 (190,0-344,0) 4	194,67±12,056 (182,0-206,0) 3	19,667±8,083 (15,00-29,00) 3	51,125±48,015 (17,50-120,0) 4	10,500±5,220 (7,000-16,50) 3
31	317. ±20,208 (294,0-329,0) 3	335,00±35,920 (311,0-387,0) 4	298. ±8,544 (289,0-306,0) 3	14,233±4,654 (9,700-19,00) 3	109,25±56,234 (27,00-150,0) 4	6,200±8,536 (5,300-10,00) 3	209,33±17,244 (194,0-228,0) 3	350,50±85,905 (224,0-412,0) 4	208,667±9,019 (200,0-218,0) 3	28,333±9,074 (20,00-38,00) 3	53,750±29,804 (17,00-90,00) 4	12,167±3,686 (8,000-15,00) 3
30	331. ±4,510 (327,0-336,0) 3	371. ±46,024 (327,0-434,0) 4	312. ±2,519 (310,0-315,0) 3	11,667±1,528 (10,00-13,00) 3	126,75±79,303 (27,00-200,0) 4	10,267±0,643 (9,800-11,00) 3	224,00±12,490 (214,0-238,0) 3	391,50±75,708 (286,0-458,0) 4	220,000±5,292 (214,0-224,0) 3	28,067±9,815 (23,00-40,00) 3	51,500±27,538 (21,00-87,00) 4	16,500±1,323 (15,50-18,00) 3
29	336. ±4,583 (331,0-340,0) 3	387. ±75,655 (320,0-494,0) 4	315. ±1,732 (313,0-316,0) 3	12,933±2,759 (9,800-15,00) 3	126,50±74,536 (26,00-200,0) 4	12,000±2,000 (10,00-14,00) 3	226,000±8,718 (220,0-236,0) 3	409,00±54,369 (336,0-466,0) 4	218,667±8,084 (210,0-226,0) 3	32,000±7,937 (23,00-38,00) 3	50,750±22,736 (26,00-81,00) 4	19,333±3,786 (15,00-22,00) 3
28	343. ±7,372 (338,0-352,0) 3	418. ±78,730 (363,0-530,0) 4	318. ±3,513 (315,0-322,0) 3	13,500±7,399 (8,500-22,00) 3	162,25±101,56 (29,00-270,0) 4	12,333±1,528 (11,00-14,00) 3	234,67±19,009 (216,0-254,0) 3	483,00±82,114 (372,0-570,0) 4	222,667±14,19 (210,0-238,0) 3	32,667±10,786 (25,00-45,00) 3	65,000±28,717 (29,00-98,00) 4	19,167±3,014 (16,00-22,00) 3
27	352. ±11,358 (344,0-365,0) 3	419. ±73,735 (364,0-525,0) 4	324. ±4,510 (320,0-329,0) 3	9,667±2,309 (7,000-11,00) 3	172,0±111,726 (28,00-290,0) 4	12,667±2,517 (10,00-15,00) 3	226,000±3,464 (222,0-228,0) 3	502,50±81,066 (418,0-606,0) 4	220,67±16,042 (204,0-236,0) 3	32,333±5,033 (27,00-37,00) 3	68,500±31,796 (26,00-103,0) 4	21,667±2,517 (19,00-24,00) 3
26	370. ±4,727 (367,0-376,0) 3	437. ±84,927 (377,0-560,0) 4	337. ±2,646 (334,0-339,0) 3	12,000±2,646 (10,00-15,00) 3	188,50±122,62 (44,00-340,0) 4	11,667±2,082 (10,00-14,00) 3	266,000±5,292 (262,0-272,0) 3	548,50±93,315 (484,0-686,0) 4	224,667±7,025 (218,0-232,0) 3	50,333±4,163 (47,00-55,00) 3	89,000±10,739 (73,00-96,00) 4	21,333±2,021 (19,50-23,50) 3
25	387. ±5,133 (382,0-392,0) 3	469. ±75,721 (398,0-570,0) 4	350. ±10,017 (341,0-361,0) 3	14,333±3,786 (10,00-17,00) 3	188,50±79,806 (94,00-280,0) 4	11,333±2,082 (9,000-13,00) 3	260,000±7,211 (254,0-268,0) 3	568,00±36,037 (548,0-622,0) 4	247,33±22,031 (222,0-262,0) 3	40,667±5,132 (35,00-45,00) 3	119,25±43,912 (80,00-173,0) 4	25,633±2,021 (24,00-28,00) 3
24	413. ±18,771 (397,0-434,0) 3	464. ±69,028 (396,0-560,0) 4	*	7,450±0,071 (7,400-7,500) 2	96,500±65,572 (18,00-160,0) 4	*	387,33±183,54 (262,0-598,0) 3	435,00±56,980 (362,0-486,0) 4	*	121,0±143,847 (33,00-287,0) 3	66,000±33,586 (22,00-100,0) 4	*
23	294. ±1,159 (294,0-296,0) 3	297. ±3,000 (297,0-302,0) 4	287. ±5,860 (281,0-292,0) 3	11,167±2,466 (9,500-14,00) 3	49,000±43,825 (10,00-100,0) 4	4,333±0,709 (3,700-5,100) 3	188,667±7,025 (182,0-196,0) 3	236,00±40,497 (182,0-270,0) 4	197,667±3,057 (194,0-200,0) 3	15,333±4,041 (11,00-19,00) 3	36,125±25,233 (16,00-72,50) 4	9,333±4,537 (6,000-14,50) 3
22	531. ±129,89 (382,0-615,0) 3	697. ±34,795 (645,0-725,0) 4	655. ±67,639 (585,0-720,0) 3	6,700±0,000 (6,700-6,700) 1	6,767±2,053 (4,500-8,500) 3	5,233±0,473 (4,700-5,600) 3	842,0±612,157 (222,0-1448,) 3	461,0±115,198 (326,0-606,0) 4	426,00±32,741 (390,0-454,0) 3	543,33±550,06 (14,00-1113,) 3	77,75±124,187 (13,00-264,0) 4	17,000±1,803 (15,50-19,00) 3
21	500. ±32,787 (465,0-530,0) 3	529. ±99,701 (444,0-660,0) 4	474. ±51,000 (423,0-525,0) 3	8,100±0,000 (8,100-8,100) 1	106,00±74,032 (19,00-200,0) 4	17,167±22,373 (4,100-43,00) 3	386,667±66,04 (322,0-454,0) 3	470,00±34,293 (422,0-502,0) 4	413,33±51,394 (366,0-468,0) 3	99,000±51,098 (44,00-145,0) 3	51,250±35,516 (13,00-97,00) 4	119,00±22,605 (100,0-144,0) 3
20	612. ±45,962 (580,0-645,0) 2	*	*	*	*	*	690,0±296,985 (480,0-900,0) 2	*	*	280,0±254,558 (100,0-460,0) 2	*	*
19	640. ±0,000 (640,0-640,0) 1	*	*	18,000±0,000 (18,00-18,00) 1	*	*	504,000±0,000 (504,0-504,0) 1	*	*	84,000±0,000 (84,00-84,00) 1	*	*

ST. #	FILTERED AMMONIA mg/1			PHENOLS ug/1			ALKALINITY mg/1			CHLORIDE mg/1		
	1978	1979		1978	1979		1978	1979		1978	1979	
	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER
32	0,182±0,157 (0,040-0,350) 3	0,104±0,078 (0,050-0,220) 4	0,108±0,037 (0,080-0,150) 3	1,000±0,000 (1,000-1,000) 3	1,000±0,000 (1,000-1,000) 4	1,000±0,000 (1,000-1,000) 3	103,000±4,243 (100,0-106,0) 2	111,000±6,325 (104,0-120,0) 6	111,000±1,414 (110,0-112,0) 2	18,500±0,500 (18,00-19,00) 3	18,125±1,031 (17,00-19,50) 4	16,667±0,577 (16,00-17,00) 3
31	0,605±0,353 (0,200-0,845) 3	0,431±0,346 (0,190-0,940) 4	0,500±0,295 (0,160-0,685) 3	1,000±0,000 (1,000-1,000) 3	1,000±0,000 (1,000-1,000) 4	1,000±0,000 (1,000-1,000) 3	113,333±4,163 (110,0-118,0) 3	118,500±6,403 (112,0-124,0) 4	114,000±5,675 (110,0-118,0) 2	19,833±1,155 (18,50-20,50) 3	20,125±2,287 (18,50-23,50) 4	18,000±0,500 (17,50-18,50) 3
30	0,912±0,055 (0,855-0,965) 3	0,750±0,450 (0,295-1,250) 4	0,910±0,240 (0,670-1,150) 3	1,000±0,000 (1,000-1,000) 3	1,125±0,250 (1,000-1,500) 4	1,000±0,000 (1,000-1,000) 3	122,667±7,024 (116,0-130,0) 3	118,00±11,547 (104,0-132,0) 4	116,000±2,828 (114,0-118,0) 2	20,833±0,289 (20,50-21,00) 3	22,500±3,317 (20,00-27,00) 4	19,333±0,289 (19,00-19,50) 3
29	0,978±0,107 (0,855-1,040) 3	0,844±0,622 (0,255-1,650) 4	0,992±0,153 (0,845-1,150) 3	1,000±0,000 (1,000-1,000) 3	1,000±0,000 (1,000-1,000) 4	1,000±0,000 (1,000-1,000) 3	121,667±5,686 (117,0-128,0) 3	120,50±10,630 (108,0-134,0) 4	114,000±5,657 (110,0-118,0) 2	21,000±0,000 (21,00-21,00) 3	23,500±5,447 (19,00-31,00) 4	19,500±0,000 (19,50-19,50) 3
28	1,147±0,042 (1,100-1,180) 3	0,935±0,558 (0,500-1,700) 4	1,043±0,187 (0,830-1,180) 3	1,167±0,289 (1,000-1,500) 3	1,000±0,000 (1,000-1,000) 4	1,000±0,000 (1,000-1,000) 3	121,333±3,055 (118,0-124,0) 3	129,00±33,086 (108,0-178,0) 4	124,000±0,000 (124,0-124,0) 2	21,500±0,500 (21,00-22,00) 3	25,375±5,391 (20,50-32,50) 4	20,167±0,289 (20,00-20,50) 3
27	1,240±0,035 (1,200-1,280) 3	0,960±0,537 (0,495-1,700) 4	1,247±0,231 (0,980-1,380) 3	1,167±0,289 (1,000-1,500) 3	1,125±0,250 (1,000-1,500) 4	1,000±0,000 (1,000-1,000) 3	126,667±2,310 (124,0-128,0) 3	118,50±13,404 (108,0-136,0) 4	120,000±8,485 (114,0-126,0) 2	22,500±1,000 (21,50-23,50) 3	25,125±4,837 (21,50-32,00) 4	20,833±0,289 (20,50-21,00) 3
26	1,650±0,187 (1,480-1,850) 3	1,001±0,567 (0,535-1,800) 4	1,477±0,177 (1,250-1,600) 3	1,667±1,155 (1,000-3,000) 3	1,000±0,000 (1,000-1,000) 4	1,000±0,000 (1,000-1,000) 3	136,000±5,292 (130,0-140,0) 3	114,500±7,895 (108,0-124,0) 4	123,000±1,414 (122,0-124,0) 2	23,667±0,764 (23,00-24,50) 3	26,125±6,019 (21,50-34,50) 4	22,667±2,021 (21,50-25,00) 3
25	1,827±0,352 (1,500-2,200) 3	0,844±0,199 (0,585-1,000) 4	1,550±0,288 (1,220-1,750) 3	5,667±7,234 (1,000-14,00) 3	1,000±0,000 (1,000-1,000) 3	1,333±0,577 (1,000-2,000) 3	130,667±7,024 (124,0-138,0) 3	115,00±15,100 (100,0-128,0) 4	128,000±0,000 (128,0-128,0) 1	26,333±1,041 (25,50-27,50) 3	27,500±5,930 (22,50-35,00) 4	24,500±1,803 (22,50-26,00) 3
24	1,172±0,904 (0,135-1,800) 3	1,964±1,585 (0,455-4,300) 4	*	9,000±5,292 (3,000-13,00) 3	1,375±0,479 (1,000-2,000) 4	*	151,67±13,052 (138,0-164,0) 3	126,500±9,983 (116,0-140,0) 4	*	29,833±2,517 (27,50-32,50) 3	27,125±6,909 (21,00-36,50) 4	*
23	0,078±0,058 (0,045-0,145) 3	0,120±0,077 (0,010-0,175) 4	0,110±0,018 (0,095-0,130) 3	1,167±0,289 (1,000-1,500) 3	1,750±1,500 (1,000-4,000) 4	1,500±0,500 (1,000-2,000) 3	98,000±7,211 (90,00-104,0) 3	115,500±6,403 (106,0-120,0) 4	*	18,167±0,289 (18,00-18,50) 3	18,000±0,404 (17,50-18,50) 4	18,000±1,000 (17,00-19,00) 3
22	3,327±2,363 (0,730-5,350) 3	17,550±8,378 (12,00-30,00) 4	0,328±0,101 (0,220-0,420) 3	12,500±11,057 (4,000-25,00) 3	9,250±14,169 (2,000-30,50) 4	1,000±0,000 (1,000-1,000) 3	146,00±31,432 (110,0-168,0) 3	197,00±21,572 (174,0-220,0) 4	*	35,000±9,962 (23,50-41,00) 3	57,125±2,626 (55,50-61,00) 4	80,167±22,418 (59,50-104,0) 3
21	1,153±1,144 (0,285-2,450) 3	0,486±0,400 (0,600-0,925) 4	2,353±0,283 (2,180-2,680) 3	8,167±9,828 (2,000-19,50) 3	1,000±0,000 (1,000-1,000) 4	1,167±0,289 (1,000-1,500) 3	185,67±16,743 (176,0-205,0) 3	121,000±6,831 (112,0-128,0) 4	*	37,000±2,646 (34,00-39,00) 3	29,000±7,036 (21,50-38,00) 4	40,000±9,179 (33,50-50,50) 3
20	0,607±0,555 (0,215-1,000) 2	*	*	5,250±4,596 (2,000-8,500) 2	*	*	232,50±10,607 (225,0-240,0) 2	*	*	41,750±1,061 (41,00-42,50) 2	*	*
19	0,260±0,000 (0,260-0,260) 1	*	*	2,000±0,000 (2,000-2,000) 1	*	*	235,000±0,000 (235,0-235,0) 1	*	*	48,000±0,000 (48,00-48,00) 1	*	*

ST. N	TOTAL PHOSPHORUS mg/l			REACTIVE PHOSPHORUS mg/l			NITRATE & NITRITE mg/l			KJELDAHL mg/l		
	1978	1979		1978	1979		1978	1979			1980	
	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER	SEPTEMBER	APRIL	SEPTEMBER
32	0,084±0,053 (0,037-0,142) 3	0,057±0,020 (0,036-0,079) 4	0,040±0,015 (0,026-0,055) 3	0,033±0,024 (0,011-0,058) 3	0,019±0,007 (0,012-0,026) 4	0,013±0,005 (0,010-0,019) 3	0,107±0,006 (0,100-0,110) 3	0,857±0,497 (0,390-1,560) 4	0,103±0,038 (0,060-0,130) 3	0,678±0,320 (0,350-0,990) 3	0,555±0,145 (0,430-0,700) 4	0,510±0,076 (0,430-0,580) 3
31	0,274±0,150 (0,105-0,380) 3	0,193±0,071 (0,111-0,266) 4	0,113±0,055 (0,050-0,146) 3	0,124±0,072 (0,045-0,178) 3	0,051±0,015 (0,036-0,069) 4	0,054±0,029 (0,020-0,071) 3	0,070±0,020 (0,050-0,090) 3	2,532±2,196 (0,630-5,700) 4	0,200±0,095 (0,090-0,260) 3	1,632±0,861 (0,645-2,230) 3	1,387±0,554 (0,950-2,200) 4	1,640±0,502 (0,460-1,340) 3
30	0,427±0,049 (0,370-0,460) 3	0,242±0,013 (0,288-0,258) 4	0,202±0,029 (0,172-0,230) 3	0,185±0,024 (0,157-0,199) 3	0,076±0,040 (0,049-0,135) 4	0,104±0,017 (0,091-0,123) 3	0,050±0,010 (0,040-0,060) 3	3,225±1,905 (1,000-5,300) 4	0,297±0,061 (0,230-0,350) 3	2,183±0,176 (2,000-2,350) 3	1,750±0,445 (1,100-2,100) 4	1,577±0,258 (1,280-1,750) 3
29	0,466±0,035 (0,430-0,500) 3	0,259±0,045 (0,226-0,325) 4	0,223±0,021 (0,204-0,245) 3	0,217±0,011 (0,209-0,229) 3	0,084±0,051 (0,040-0,158) 4	0,113±0,008 (0,104-0,120) 3	0,043±0,006 (0,040-0,050) 3	4,875±2,238 (2,200-7,500) 4	0,307±0,032 (0,270-0,330) 3	2,290±0,036 (2,250-2,320) 3	2,040±0,708 (1,300-3,000) 4	1,750±0,205 (1,540-1,950) 3
28	0,597±0,015 (0,580-0,610) 3	0,387±0,039 (0,350-0,430) 4	0,248±0,029 (0,215-0,270) 3	0,276±0,025 (0,260-0,305) 3	0,101±0,043 (0,077-0,165) 4	0,125±0,008 (0,115-0,130) 3	0,030±0,000 (0,030-0,030) 3	6,525±1,806 (4,800-8,500) 4	0,313±0,021 (0,290-0,330) 3	2,817±0,146 (2,650-2,920) 3	2,542±0,698 (1,800-3,220) 4	1,950±0,132 (1,800-2,050) 3
27	0,840±0,159 (0,720-1,020) 3	0,346±0,047 (0,296-0,410) 4	0,307±0,073 (0,240-0,385) 3	0,322±0,045 (0,275-0,365) 3	0,092±0,045 (0,054-0,157) 4	0,152±0,023 (0,125-0,169) 3	0,020±0,010 (0,010-0,030) 3	6,750±1,634 (5,400-8,700) 4	0,317±0,012 (0,310-0,330) 3	3,450±0,776 (2,700-4,250) 3	2,567±0,260 (2,300-2,850) 4	2,217±0,501 (1,700-2,700) 3
26	1,190±0,095 (1,090-1,280) 3	0,494±0,124 (0,370-0,630) 4	0,412±0,068 (0,370-0,490) 3	0,483±0,041 (0,455-0,530) 3	0,114±0,053 (0,070-0,190) 4	0,227±0,006 (0,220-0,230) 3	0,010±0,000 (0,010-0,010) 3	7,950±1,718 (6,000-10,10) 4	0,387±0,080 (0,310-0,470) 3	4,750±0,218 (4,600-5,000) 3	3,185±0,559 (2,800-4,000) 4	2,583±0,202 (2,400-2,800) 3
25	1,570±0,481 (1,160-2,100) 3	0,622±0,377 (0,355-1,180) 4	0,520±0,053 (0,460-0,560) 3	0,672±0,199 (0,500-0,890) 3	0,187±0,182 (0,084-0,460) 4	0,297±0,051 (0,265-0,355) 3	0,013±0,006 (0,010-0,020) 3	9,850±2,198 (7,800-12,30) 4	0,463±0,142 (0,300-0,550) 3	6,683±1,546 (5,400+8,400) 3	3,840±1,599 (2,700-6,200) 4	2,650±0,350 (2,400-3,050) 3
24	2,467±1,422 (1,500-4,100) 3	0,665±0,360 (0,340-1,180) 4	*	0,613±0,164 (0,490-0,800) 3	0,362±0,364 (0,069-0,850) 4	*	0,013±0,006 (0,010-0,020) 3	8,950±3,750 (4,800-13,40) 4	*	11,267±7.998 (6.500-20.50) 3	4,687±1,827 (2,500-6,600) 4	*
23	0,061±0,027 (0,031-0,083) 3	0,088±0,040 (0,048-0,129) 4	0,064±0,026 (0,044-0,094) 3	0,021±0,017 (0,009-0,041) 3	0,038±0,020 (0,017-0,056) 4	0,023±0,023 (0,001-0,046) 3	0,140±0,026 (0,110-0,160) 3	0,535±0,174 (0,370-0,780) 4	0,177±0,029 (0,160-0,210) 3	0,473±0,157 (0,305-0,615) 3	0,582±0,128 (0,440-0,730) 4	0,450±0,044 (0,420-0,500) 3
22	8,413±6,497 (1,040-13,30) 3	4,615±4,295 (1,900-11,00) 4	1,857±0,386 (1,430-2,180) 3	2,060±1,662 (0,151-3,180) 3	2,875±3,265 (0,550-7,500) 4	1,543±0,436 (1,090-1,960) 3	0,017±0,012 (0,010-0,030) 3	0,320±0,087 (0,220-0,430) 4	6,917±2,574 (4,850-9,800) 3	47,700±39,089 (4,800-81,30) 3	30,300±11,146 (21,00-46,00) 4	2,927±0,142 (2,800-3,080) 3
21	3,100±0,676 (2,450-3,800) 3	0,524±0,666 (0,139-1,520) 4	2,367±0,390 (1,980-2,760) 3	1,070±0,439 (0,750-1,570) 3	0,073±0,063 (0,040-0,168) 4	1,298±0,753 (0,765-2,160) 3	0,023±0,012 (0,010-0,030) 3	9,277±5,987 (0,710-13,50) 4	0,997±0,708 (0,520-1,810) 3	13,433±3,044 (10,00-15,80) 3	2,527±1,801 (1,400-5,200) 4	6,467±1,102 (5,200-7,200) 3
20	4,625±0,106 (4,550-4,700) 2	*	*	1,230±0,113 (1,150-1,310) 2	*	*	0,035±0,007 (0,030-0,040) 2	*	*	19,300±2.121 (17,80-20,80) 2	*	*
19	3,850±0,000 (3,850-3,850) 1	*	*	1,200±0,000 (1,200-1,200) 1	*	*	0,030±0,000 (0,030-0,030) 1	*	*	16,000±0,000 (16,00-16,00) 1	*	*

SITE #	FECAL COLIFORM counts/100ml 1978 SEPTEMBER	FECAL COLIFORM 1979 APRIL	FECAL COLIFORM 1979 SEPTEMBER	FECAL STREPTOCOCCI counts/100ml 1978 SEPTEMBER	FECAL STREPTOCOCCI 1979 APRIL	FECAL STREPTOCOCCI 1979 SEPTEMBER	PSEUDOMONAS counts/100ml 1978 SEPTEMBER	PSEUDOMONAS 1979 APRIL	PSEUDOMONAS 1979 SEPTEMBER	PH IN FIELD 1978 SEPTEMBER	PH IN FIELD 1979 APRIL	PH IN FIELD 1979 SEPTEMBER
32	112. 11-914 3	11. 3-55 4	38. 9-165 3	142. 13-1503 3	68. 36-127 4	26. 5-134 3	5. 3-11 3	4. 4-4 4	4. 4-4 3	7,650±0,000 (7,650-7,650) 1	*	*
31	331. 29-3771 3	123. 61-251 4	82. 13-525 3	407. 16-10572 3	370. 154-887 4	43. 16-120 3	6. 3-17 3	5. 3-9 4	4. 4-4 3	7,977±0,599 (7,310-8,470) 3	*	*
30	1018. 654-1586 3	186. 87-3987 4	119. 80-180 2	761. 8 78-7428 3	775. 237-2542 4	95. 80-114 2	6. 4-19 3	7. 2-27 4	4. 4-4 2	7,773±0,560 (7,260-8,370) 3	*	*
29	2565. 2450-2687 3	282. 127-630 4	101. 43-242 3	1322. 371-4708 3	1155. 469-2844 4	76. 31-189 3	36. 22-61 3.	11. 2-63 4	4. 4-4 3	7,740±0,558 (7,220-8,330) 3	*	*
28	3693. 2487-6094 3	467. 285-767 4	211. 120-375 3	4035. 842-19341 3	2525. 1160-5497 4	120. 38-384 3	60. 25-148 3	9. 4-23 4	4. 4-4 3	7,650±0,562 (7,200-8,280) 3	*	*
27	8946. 3928-20374 2	351. 140-880 4	446. 215-928 3	3041. 1803-5131 2	2356. 1130-4915 4	98. 12-798 3	158. 76-320 2	8. 5-14 4	5. 3-8 3	7,647±0,466 (7,320-8,180) 3	*	*
26	24367. 21057-28198 2	868. 446-1693 4	714. 396-1288 3	41109. 8070-209400 2	3377. 19902-5733 4	471. 310-720 3	383. 164-898 2	15. 11-22 4	7. 4-14 3	7,450±0,547 (6,960-8,040) 3	*	*
25	39775. 27973-565576 2	893. 405-1972 4	2203. 1289-3767 3	76038. 9145-632225 2	7244. 3314-15835 4	1413. 268-7450 3	37. 6-242 2	11. 4-34 4	5.43 3-9 3	7,443±0,551 (7,000-8,060) 3	*	*
24	135131. 15321-1191829 2	1083. 221-5313 4	*	345932. 23718-5045463 2	16865. 6809-41773 4	*	14-139 2	21. 7-71 4	*	7,487±0,660 (6,830-8,150) 3	*	*
23	16. 6-35 2	51. 5-592 3	73. 13-421 3	61. 24-158 2	152. 45-516 4	153. 14-1629 3	5. 3-9 2	4. 4-4 3	25. 4-145 3	8,453±0,603 (7,890-9,090) 3	*	*
22	889131. 321579-245834 3 *	7669. 2109-27889 4	24100. 16482-35242 3	372130. 26930-5142243 3	573779. 154199-213504 * 4	309279. 52680-1815733 3	7. 4-13 3	7. 4-14 4	10. 10-10 3	7,647±0,230 (7,420-7,880) 3	*	*
21	157314. 26796-923568 2	481. 242-960 4	22994. 22994-22994 1	491884. 59160-4089773 2	221. 44-1129 4	4769. 4770-4770 1	34. 6-201 2	6. 2-19 4	10. 10-10 1	7,503±0,754 (6,800-8,300) 3	*	*
20	*	*	*	*	*	*	*	*	*	8,655±1,973 (7,260-10,05) 2	*	*
19	11003. 11004-11004 1	*	*	28001. 28001-28001 1	*	*	80. 80-80 1	*	*	7,820±0,000 (7,820-7,820) 1	*	*

APPENDIX II Water Quality for Adjacent Lake Erie Stations

Parameter	Units
Dissolved Oxygen	mg/L
Conductivity	us/cm
Turbidity	FTU
Fecal Coliform	count/100 mL
Fecal Streptococci	count/100 mL
Filtered Ammonia	mg/L
Total Alkalinity	mg/L
Chloride	mg/L
Chlorophyll *a*	ug/L
Secchi Disc	m
Nitrate + Nitrite	mg/L
Total Phosphorus	mg/L
Reactive Phosphorus	mg/L
Reactive Silicate	mg/L

APPENDIX II Water Quality Data for Adjacent Lake Erie Stations

STATION #	DISSOLVED OXYGEN mg/l		CONDUCTIVITY us/cm		TURBIDITY FTU		FECAL COLIFORM counts/100ml		FECAL STREPTOCOCCI counts/100ml	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
687	13.27±0.21 (13.1-13.5) 3	7.90±0.61 (7.4-8.6) 3	285± 5 (280-292) 4	281± 6 (275-286) 4	44.50±30.64 (18.0-78.0) 4	5.20±1.80 (3.30-6.80) 3	5. (4.-8.) 3	10. (4.-28.) 3	24. (4.-68.) 3	10. (4.-24) 3
688	13.10±0.10 (13.0-13.2) 3	7.70±1.03 (6.6-8.6) 3	289± 7 (283-299) 4	283± 7 (276-290) 3	58.00±58.19 (11.0-140.) 4	5.70±1.10 (4.90-6.90) 3	9. (4.-40.) 3	6. (4.-12.) 3	26. (12.-76.) 3	6. (4.-12.) 3
689	13.27±0.31 (12.9-13.6) 4	7.80±1.05 (6.7-8.8) 3	287± 8 (282-299) 4	281± 9 (273-290) 3	47.25±26.00 (17.0-74.0) 4	5.40±2.40 (2.80-7.60) 3	18. (4.-190.) 3	4. (4.-4.) 3	83. (44.-272.) 3	4. (4.-4.) 3
690	12.95±0.21 (12.8-13.1) 2	7.70±0.79 (7.10-8.60) 3	290 ± 6 (284-297) 4	284 ± 8 (276-291) 3	5.35±3.410 (2.20-9.00) 4	6.03±1.270 (5.20-7.50) 3	27. (12.-80.) 4	22. (4.-136.) 3	44. (12.-144.) 4	48. (16.-92.) 3
692	12.83±0.38 (12.4-13.1) 3	7.87±0.73 (7.30-8.70) 3	286 ± 3 (284-290) 4	282 ± 4 (277-285) 3	4.80±3.465 (1.80-7.90) 4	4.23±1.040 (3.40-5.40) 3	15. (6.-44.) 4	5. (4.-8.) 3	31. (16.-52.) 4	36. (4.-720.) 3
694	13.17±0.21 (13.0-13.4) 3	7.90±0.70 (7.40-8.70) 3	286 ± 2 (280-289) 4	283 ± 4 (278-286) 3	4.75±3.353 (1.70-7.80) 4	3.70±0.620 (3.20-4.40) 3	9. (4.-20.) 4	4. (4.-4.) 3	37. (4.-136.) 4	4. (4.-4.) 3
696	13.23±0.45 (12.8-13.7) 3	7.90±0.76 (7.10-8.80) 3	288 ± 4 (283-293) 4	283 ± 5 (277-287) 3	5.18±3.669 (1.90-8.50) 4	4.10±0.520 (3.80-4.70) 3	17. (4.-76.) 3	4. (4.-4.) 3	51. (24.-84.) 3	8. (4.-36.) 3
697	13.17±0.55 (12.6-13.7) 3	7.90±0.85 (7.10-8.80) 3	288 ± 6 (281-295) 4	281 ± 4 (276-284) 3	5.60±3.866 (2.30-9.70) 4	5.23±1.960 (3.40-7.30) 3	12. (4.-36.) 4	19. (8.-32.) 3	20. (4.-84.) 4	18. (4.-40.) 3

STATION #	DISSOLVED OXYGEN mg/1		CONDUCTIVITY us/cm		TURBIDITY FTU		FECAL COLIFORM counts/100ml		FECAL STREPTOCOCCI counts/100ml	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
714	13.27±0.15 (13.1-13.4) 3	7.87±0.85 (7.20-8.70) 3	292 ± 8 (282-302) 4	281 ± 5 (275-295) 3	5.40±3.076 (2.60-8.40) 4	5.97±2.660 (3.70-8.90) 3	43. (20.-72.) 4	7. (4.-20.) 3	56. (28.-112.) 4	23. (4.-64.) 3
715	13.10±0.30 (12.8-13.4) 3	7.73±0.76 (7.20-8.40) 3	291 ± 9 (283-302) 4	284 ± 5 (278-287) 3	5.60±3.793 (2.20-10.0) 4	4.67±2.150 (2.60-6.90) 3	20. (4.-76.) 4	9. (4.-48.) 3	45. (16.-124.) 4	24. (4.-136.) 3
716	13.17±0.15 (13.0-13.3) 3	7.93±0.55 (8.20-8.30) 3	286 ± 5 (283-293) 4	283 ± 4 (279-286) 3	4.25±2.548 (2.10-7.10) 4	3.77±0.670 (3.20-4.50) 3	12. (4.-24.) 4	8. (4.-32.) 3	26. (12.-64.) 4	5. (4.-8.) 3
717	13.35±0.21 (13.2-13.5) 2	8.00±0.53 (7.40-8.40) 3	285 ± 4 (281-290) 4	283 ± 3 (279-285) 3	3.85±2.490 (1.70-6.80) 4	3.40±0.660 (2.80-4.10) 3	8. (4.-20.) 4	7. (4.-12.) 3	14. (4.-36.) 4	4. (4.-4.) 3
718	13.23±0.25 (13.0-13.5) 3	7.97±0.51 (7.40-8.40) 3	285 ± 3 (282-288) 4	282 ± 4 (277-284) 3	4.23±3.120 (1.10-7.20) 4	3.33±0.420 (3.00-3.80) 3	7. (4.-20.) 4	8. (4.-28.) 3	27. (8.-44.) 4	4. (4.-4.) 3
719	13.40±0.35 (13.0-13.6) 3	7.97±0.65 (7.30-8.60) 3	287 ± 3 (283-289) 4	282 ± 4 (277-285) 3	5.18±3.922 (1.50-9.00) 4	3.87±0.513 (3.30-4.30) 3	19. (4.-68.) 3	9. (4.-40.) 3	55. (40.-64.) 3	4. (4.-4.) 3
814	13.43±0.06 (13.4-13.5) 3	7.87±0.61 (7.20-8.40) 3	289 ± 5 (282-295) 4	282 ± 5 (277-286) 3	5.28±3.523 (2.20-9.20) 4	4.53±1.020 (3.80-5.70) 3	9. (4.-48.) 4	4. (4.-4.) 3	19. (4.-68.) 4	7. (4.-20.) 3
815	13.20±0.14 (13.1-13.3) 2	7.73±0.83 (6.80-8.40) 3	291 ± 9 (283-300) 3	282 ± 7 (274-288) 3	6.43±3.323 (2.60-8.50) 3	6.73±2.511 (4.60-9.50) 3	15. (4.-48.) 3	20. (16.-32.) 3	55. (28.-88.) 3	26. (4.-116.) 3
822	13.30±0.26 (13.0-13.5 3	7.90±0.62 (7.2-8.4) 3	289± 9 (282-302) 4	283± 3 (277-287) 3	41.25±27.94 (11.0-66.0) 4	5.10±2.20 (3.40-7.60) 3	12. (4.-28.) 4	6. (4.-12.) 3	25. (8.-100.) 4	11. (4.-40.) 3
823	13.50±0.42 (13.2-13.8 2	8.10±0.36 (7.7-8.4) 3	290± 9 (281-300) 4	282± 5 (277-286) 3	36.50±28.05 (15.0-74.0) 4	4.90±1.60 (3.90-6.80) 3	6. (4.-16.) 4	5. (4.-8.) 3	25. (4.-168.) 4	4. (4.-4.) 3
824	13.27±0.12 (13.2-13.4 3	8.20±0.21 (8.0-8.4) 3	291± 10 (283-303) 4	282± 5 (277-285) 3	40.50±26.65 (16.0-70.0) 4	3.40±0.25 (3.10-3.60) 3	6. (4.-8.) 4	4. (4.-4.) 3	41. (12.-112.) 4	6. (4.-12.) 3

STATION #	FILTERED AMMONIA mg/l		TOTAL ALKALINITY mg/l		CHLORIDE mg/l		CHLOROPHYLL A ug/l		SECCHI DISC m	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
687	0.021±0.006 (.015-.030) 4	0.030±0.001 (.020-.040) 3	106.0±9.80 (98.0-118.) 4	106.0±2.83 (104.-108.) 3	17.4±0.40 (17.0-18.0) 4	16.3±0.58 (16.0-17.0) 3	6.10±1.970 (4.90-8.40) 3	8.17±1.980 (6.40-10.3) 3	0.20±0.008 (0.10-0.30) 4	1.20±0.25 (1.00-1.50) 3
688	0.035±0.020 (.020-.065) 4	0.048±0.049 (.015-.105) 3	112.0±10.12 (100.-120.) 4	109.0±7.07 (104.-114.) 2	17.5±0.40 (17.0-18.0) 4	16.8±0.58 (16.5-17.5) 3	5.70±1.070 (5.00-6.90) 3	7.90±1.570 (6.10-9.00) 3	0.28±0.17 (0.10-0.50) 4	1.00±0.006 (1.00-1.10) 3
689	0.027±0.013 (.015-.045) 4	0.035±0.002 (.010-.075) 3	107.0±5.97 (100.-114.) 4	108.0±5.66 (104.-112.) 2	17.4±0.50 (17.0-18.0) 4	16.3±0.58 (16.0-17.0) 3	5.70±1.270 (4.80-6.60) 2	8.20±1.660 (6.60-9.90) 3	0.20±0.008 (0.10-0.30) 4	1.20±0.007 (1.10-1.20) 2
690	0.057±0.053 (.020-.135) 4	0.077±0.038 (.040-.115) 3	106.0±12.17 (98.0-100.) 3	103.0±1.41 (102.-103.) 2	17.9±0.75 (17.0-18.5) 4	17.2±0.76 (16.5-18.0) 3	5.70±1.27 (4.80-6.60) 2	8.17±1.66 (6.60-9.90) 3	0.23±0.06 (0.20-0.30) 3	1.03±0.25 (0.80-1.30) 3
692	0.031±0.009 (0.02-0.04) 4	0.027±0.016 (.015-.045) 3	108.7±7.02 (102.-116.) 3	100.0±2.83 (98.-102.) 2	17.4±0.48 (17.0-18.0) 4	17.3±5.77 (17.0-18.0) 3	6.60±2.00 (5.30-8.90) 3	7.47±1.65 (5.80-9.10) 3	0.23±0.05 (0.20-0.30) 4	1.13±0.12 (1.00-1.20) 3
694	0.030±0.007 (.025-.040) 4	0.037±0.029 (.015-.070) 3	110.0±13.86 (102.-126.) 3	108.±0.00 (108.-108.) 1	17.3±0.29 (17.0-17.5) 4	17.3±0.29 (17.0-17.5) 3	7.83±4.09 (4.50-12.4) 3	7.63±2.58 (5.30-10.4) 3	0.25±0.10 (0.20-0.40) 4	1.10±0.17 (0.90-1.20) 3
696	0.031±0.009 (0.02-0.04) 4	0.022±0.013 (.010-.035) 3	107.3±8.33 (98.0-114.) 3	103.0±4.24 (100.-106.) 2	17.5±0.41 (17.0-18.0) 4	17.0±0.50 (16.5-17.5) 3	6.87±1.19 (5.90-8.20) 3	4.83±2.71 (2.00-7.40) 3	0.23±0.05 (0.20-0.30) 4	1.03±0.06 (1.00-1.10) 3
697	0.024±0.018 (.005-.045) 4	0.033±0.008 (.025-.040) 3	106.7±5.77 (100.-110.) 3	102.0±2.83 (100.-104.) 2	17.9±0.48 (17.5-18.5) 4	17.2±0.76 (16.5-18.0) 3	6.33±2.22 (4.50-8.80) 3	9.03±0.38 (8.50-9.20) 3	0.20±0.00 (0.20-0.20) 4	0.93±0.21 (0.70-1.10) 3

STATION #	FILTERED AMMONIA mg/l		TOTAL ALKALINITY mg/l		CHLORIDE mg/l		CHLOROPHYLL A ug/l		SECCHI DISC m	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
714	0.057±0.032 (.015-.085) 4	0.037±0.015 (0.02-0.05) 3	114.7±13.32 (100.-126.) 3	103.5±2.12 (102.-105.) 2	18.1+0.63 (17.5-19.0) 4	16.8+1.04 (16.0-18.0) 3	7.30±0.90 (6.40-8.20) 3	8.20±1.56 (7.10-9.30) 2	0.20±0.00 (0.20+0.20) 4	1.03±0.25 (0.80-1.30) 3
715	0.066±0.068 (.020-.165) 4	0.062±0.010 (0.05-0.07) 3	107.33±7.02 (100.-114.) 3	109.0±7.07 (104.-114.) 2	18.0+0.91 (17.0-19.0) 4	17.0+0.50 (16.5-17.5) 3	6.97±1.56 (5.50-8.60) 3	9.47±1.96 (7.30-11.1) 3	0.23±0.06 (0.20-0.30) 3	1.30±0.00 (1.30-1.30) 2
716	0.027±0.012 (.015-.040) 4	0.050±0.026 (0.02-0.07) 3	106.7±3.32 (98.0-122.) 3	106.0±2.83 (104.-108.) 2	17.5+0.41 (17.0-18.0) 4	17.0+0.50 (16.5-17.5) 3	6.00±1.48 (5.00-7.70) 3	7.73±0.55 (7.20-8.30) 3	0.17±0.06 (0.10-0.20) 3	1.30±0.00 (1.30-1.30) 3
717	0.024±0.013 (0.01-0.04) 4	0.025±0.009 (.020-.035) 3	105.67±6.03 (100.-112.) 3	105.0±1.41 (104.-106.) 2	17.4+0.48 (17.0-18.0) 4	17.0+0.50 (16.0-18.0) 3	6.60±2.21 (4.90-9.10) 3	8.07±1.96 (5.90-9.70) 3	0.30±0.14 (0.20-0.50) 4	1.33±0.29 (1.00-1.50) 3
718	0.022±0.005 (0.02-0.03) 4	0.023±0.010 (.015-.035) 3	106.67±9.87 (100.-118.) 3	108.0±5.66 (104.-112.) 2	17.4+0.25 (17.0-17.5) 4	17.7+1.04 (16.5-18.5) 3	6.97±1.97 (5.50-9.20) 3	7.80±2.04 (5.50-9.40) 3	0.28±0.10 (0.20-0.40) 4	1.23±0.51 (0.80-1.80) 3
719	0.029±0.012 (.020-.045) 4	0.025±0.013 (.015-.040) 3	110.0±9.17 (100.-118.) 3	106.0±5.66 (102.-110.) 2	17.5+0.41 (17.0-18.0) 4	17.2+1.04 (16.0-18.0) 3	6.07±0.68 (5.30-6.60) 3	8.00±1.51 (6.80-9.70) 3	0.28±0.15 (0.20-0.50) 4	1.50±0.00 (1.50-1.50) 3
814	0.030±0.011 (.015-.040) 4	0.025±0.013 (.015-.040) 3	110.7±9.45 (100.-118.) 3	104.0±2.83 (102.-106.) 2	17.8+0.50 (17.0-18.0) 4	16.8+0.76 (16.0-17.5) 3	5.90±0.70 (5.20-6.60) 3	8.07±1.54 (6.30-9.10) 3	0.23±0.13 (0.10-0.40) 4	1.20±0.14 (1.10-1.13) 2
815	0.043±0.026 (.015-.065) 3	0.053±0.008 (.045-.060) 3	112.7±9.45 (102.-120.) 3	111.0±7.07 (106.-116.) 2	18.0+0.82 (17.0-19.0) 4	17.2+0.29 (17.0-17.5) 3	5.70±0.57 (5.30-6.10) 3	8.80±0.70 (8.10-9.50) 3	0.18±0.10 (0.10-0.30) 4	0.93±0.21 (0.70-1.10) 3
822	0.032±0.020 (.015-.050) 4	0.023±0.008 (.015-.030) 3	108.0±7.21 (100.-114.) 3	107.0±1.41 (106.-108.) 2	17.8±0.60 (17.0-18.5) 4	17.0±1.00 (16.0-18.0) 3	5.80±1.190 (4.50-6.70) 3	8.67±1.620 (6.80-9.70) 3	0.25±0.17 (0.10-0.50) 4	1.20±0.38 (0.90-1.60) 3
823	0.027±0.018 (.010-.045) 4	0.025±0.009 (.020-.035) 3	106.0±5.29 (100.-110.) 3	106.0±2.83 (104.-108.) 2	17.9±0.90 (17.0-19.0) 4	16.8±0.58 (16.5-17.5) 3	7.20±0.950 (6.10-7.80) 3	8.80±2.520 (6.50-11.5) 3	0.28±0.05 (0.20-0.30) 4	1.13±0.15 (1.00-1.30) 3
824	0.029±0.014 (.015-.045) 4	0.032±0.025 (.015-.060) 3	108.0±6.93 (100.-112.) 3	105.0±1.41 (104.-106.) 2	17.9±1.00 (17.0-19.0) 4	16.7±0.58 (16.0-17.0) 3	7.10±1.500 (5.40-8.10) 3	8.00±1.810 (6.10-9.70) 3	0.28±0.010 (0.20-0.40) 4	1.27±0.006 (1.20-1.30) 3

STATION #	NITRITE & NITRATE mg/l		TOTAL PHOSPHORUS mg/l		KJELDAHL mg/l		REACTIVE PHOSPHORUS mg/l		REACTIVE SILICATE mg/l	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
687	0.437±0.124 (.290-.550) 4	0.080±0.034 (.040-.100) 3	0.056±0.013 (.036-.063) 4	0.027±0.070 (.022-.035) 3	0.397±0.061 (.310-.450) 4	0.323±4.500 (.280-.370) 3	0.008±0.004 (.005-.013) 4	0.006±0.002 (.004-.008) 3	0.10±0.040 (0.06-0.16) 4	0.14±0.069 (6.40-10.3) 3
688	0.862±0.893 (.350-2.20) 4	0.080±0.029 (.050-.100) 3	0.067±0.063 (.022-.160) 4	0.030±0.012 (.021-.044) 3	0.515±0.287 (.330-.940) 4	0.360±7.370 (.300-.440) 3	0.014±0.015 (.005-.036) 4	0.007±0.006 (.004-.014) 3	0.25±0.340 (0.06-0.76) 4	0.18±0.122 (0.10-0.32) 3
689	0.577±0.468 (.250-1.27) 4	0.080±0.026 (.050-0.10) 3	0.048±0.015 (.028-.062) 4	0.029±0.006 (.028-.029) 3	0.377±0.128 (.270-.550) 4	0.340±4.040 (.300-.380) 3	0.009±0.002 (.006-.010) 4	0.004±0.006 (.004-.005) 3	0.13±0.060 (0.08-0.22) 4	0.19±0.168 (0.08-0.38) 3
690	0.627±0.325 (.310-1.05) 4	0.093±0.021 (.070-.110) 3	0.057±0.016 (.034-.068) 4	0.033±0.012 (.023-.047) 3	0.455±0.079 (.370-.560) 4	0.410±0.095 (0.31-0.50) 3	0.011±0.007 (.005-.020) 4	0.015±0.014 (.006-.031) 3	0.14±0.02 (0.12-0.16) 4	0.10±0.00 (0.10-0.10) 2
692	0.495±0.073 (.410-.570) 4	0.080±0.026 (.050-.100) 3	0.049±0.022 (.029-.076) 4	0.018±0.002 (.016-.020) 3	0.365±0.048 (0.32-0.43) 4	0.287±0.015 (0.27-0.30) 3	0.009±0.004 (.005-.015) 4	0.004±0.002 (.002-.006) 3	0.12±0.05 (0.08-0.12) 4	0.14±0.05 (0.10-0.20) 3
694	0.455±0.095 (.380-.590) 4	0.087±0.023 (.060-.100) 3	0.055±0.019 (.030-.077) 4	0.017±0.008 (.010-.025) 3	0.447±0.075 (0.36-0.54) 4	0.313±0.114 (0.22-0.44) 3	0.009±0.003 (.004-.012) 4	0.006±0.005 (.002-.012) 3	0.11±0.04 (0.08-0.16) 4	0.14±0.05 (0.10-0.20) 3
696	0.515±0.136 (.330-.640) 4	0.080±0.026 (.050-.100) 3	0.053±0.017 (.038-.070) 4	0.021±0.005 (.017-.027) 3	0.407±0.102 (0.34-0.56) 4	0.283±0.031 (0.25-0.31) 3	0.010±0.005 (.007-.017) 4	0.004±0.002 (.003-.007) 3	0.12±0.03 (0.08-0.14) 3	0.15±0.06 (0.10-0.22) 3
697	0.645±0.219 (.320-.800) 4	0.077±0.031 (.050-.110) 3	0.053±0.019 (.037-.076) 4	0.024±0.003 (.021-.026) 3	0.325±0.079 (0.26-0.42) 4	0.313±0.035 (0.28-0.35) 3	0.008±0.002 (.006-.010) 4	0.005±0.001 (.005-.006) 3	0.15±0.05 (0.10-0.22) 4	0.15±0.09 (0.10-0.26) 3

STATION #	NITRITE & NITRATE mg/l		TOTAL PHOSPHORUS mg/l		KJELDAHL mg/l		REACTIVE PHOSPHORUS mg/l		REACTIVE SILICATE mg/l	
	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER	APRIL	SEPTEMBER
714	0.732±0.325 (.330-1.06) 4	0.087±0.032 (.050-.110) 3	0.057±0.016 (.043-.071) 4	0.025±0.002 (.023-.027) 3	0.457±0.075 (0.38-0.51) 4	0.337±0.006 (0.33-0.34) 3	0.010±0.002 (.008-.012) 4	0.006±0.001 (.005-.006) 3	0.17±0.03 (0.14-0.20) 4	0.15±0.08 (0.10-0.24) 3
715	0.665±0.377 (.310-1.17) 4	0.097±0.032 (.060-.120) 3	0.062±0.017 (.037-.079) 4	0.033±0.006 (.027-.039) 3	0.485±0.184 (0.31-0.72) 4	0.410±0.082 (0.34-0.50) 3	0.014±0.008 (.007-.025) 4	0.010±0.002 (.008-.012) 3	0.15±0.04 (0.10-0.18) 4	0.14±0.09 (0.08-0.24) 3
716	0.505±0.145 (.340-.670) 4	0.090±0.030 (.060-.120) 3	0.055±0.023 (.032-.085) 4	0.027±0.006 (.020-.031) 3	0.347±0.062 (0.26-0.40) 4	0.360±0.060 (0.30-0.42) 3	0.009±0.002 (.007-.011) 4	0.007±0.003 (.004-.009) 3	0.13±0.02 (0.12-0.16) 4	0.17±0.08 (0.10-0.26) 3
717	0.405±0.116 (.270-.550) 4	0.080±0.026 (.050-.100) 3	0.042±0.015 (.028_.059) 4	0.023±0.004 (.020-.027) 3	0.375±0.025 (0.35-0.41) 4	0.320±0.020 (0.30-0.34) 3	0.007±0.001 (.007-.008) 4	0.005±0.003 (.003-.008) 3	0.11±0.01 (0.10-0.12) 4	0.16±0.05 (0.12-0.22) 3
718	0.407±0.118 (.320-.580) 4	0.080±0.026 (.050-.100) 3	0.047±0.023 (.024-.076) 4	0.023±0.005 (.019-.028) 3	0.400±0.080 (0.30-0.47) 4	0.300±0.010 (0.29-0.31) 3	0.007±0.002 (.004-.001) 4	0.005±0.002 (.003-.006) 3	0.10±0.03 (0.06-0.14) 4	0.15±0.06 (0.10-0.22) 3
719	0.505±0.123 (.380-.660) 4	0.080±0.026 (.050-.100) 3	0.049±0.022 (.027-.070) 4	0.022±0.003 (.020-.025) 3	0.437±0.092 (0.34-0.54) 4	0.307±0.025 (0.28-0.33) 3	0.009±0.004 (.006-.014) 4	0.004±0.002 (.003-.006) 3	0.23±0.21 (0.08-0.54) 4	0.15±0.06 (0.10-0.22) 3
814	0.577±0.188 (.320-.740) 4	0.083±0.021 (.060-.100) 3	0.049±0.015 (.034-.064) 4	0.024±0.003 (.020-.026) 3	0.405±0.047 (0.36-0.47) 4	0.317±0.035 (0.28-0.35) 3	0.008±0.001 (.007-.010) 4	0.005±0.003 (.003-.008) 3	0.13±0.04 (0.08-0.19) 4	0.15±0.08 (0.10-0.24) 3
815	0.617±0.281 (.350-.910) 3	0.097±0.021 (.080-.120) 3	0.059±0.019 (.037-.074) 3	0.031±.002 (.030-.033) 3	0.367±0.055 (0.31-0.42) 3	0.417±0.015 (0.40-0.43) 3	0.009±0.003 (.006-.012) 3	0.008±0.001 (.008-.009) 3	0.16±0.0[illegible] (0.12-0.20) 4	0.17±0.10 (0.10-0.28) 3
822	0.597±0.495 (.340-1.34) 4	0.076±0.032 (.040-.100) 3	0.042±0.015 (.023-.055) 4	0.021±0.002 (.020-.023) 3	0.382±0.088 (.310-.510) 4	0.290±5.770 (.290-.300) 3	0.010±0.003 (.008-.014) 4	0.004±0.001 (.003-.005) 3	0.11±0.07 (0.04-0.20) 4	0.14±0.05 (0.10-0.20) 3
823	0.655±0.515 (.270-1.40) 4	0.076±0.032 (.040-.100) 3	0.040±0.010 (.029-.050) 4	0.029±0.004 (.026-.033) 3	0.380±0.029 (.340-.410) 4	0.360±8.080 (.310-.450) 3	0.006±0.001 (.005-.007) 4	0.004±0.001 (.003-.005) 3	0.11±0.06 (0.06-0.20) 4	0.13±0.04 (0.10-0.18) 3
824	0.710±0.552 (.280-1.48) 4	0.080±0.038 (.040-.110) 3	0.043±0.012 (.033-.058) 4	0.044±0.039 (.021-.089) 3	0.400±0.048 (.370-.470) 4	0.460±0.120 (.330-.560) 3	0.008±0.004 (.004-.013) 4	0.006±0.003 (.004-.009) 3	0.13±0.06 (0.08-0.20) 4	0.14±0.05 (0.10-0.20) 3